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Development
of
Predictive Equations Based
on
Pavement Condition Index Data

Thesis
F52283

by

Christopher V. O. Floro

A report submitted in partial fulfillment
of the requirements for the degree of

Master of Science in Civil Engineering

University of Washington
March 1992

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University of Washington

Abstract

"Development of Predictive Equations Based on Pavement Condition Index Data"

by

Christopher V. O. Floro

Committee Chairman: Professor J. P. Mahoney
Department of Civil Engineering

This research project evaluated runway pavement condition survey information in order to develop models or equations capable of predicting future pavement performance and projected life expectancy. The data was obtained from the Federal Aviation Administration (FAA), and the Washington State Department of Transportation (WSDOT). A previous research report analyzed the first set of Pavement Condition Index (PCI) data obtained from runway pavements in the tri-state area of Washington, Oregon, and Idaho. The analysis performed in this report included only runways with a second set of PCI survey data. The two primary surface categories evaluated were flexible and rigid pavements. The former includes asphalt concrete (AC) original surface courses, AC overlays, bituminous surface treatments (BST's), and slurry seal maintenance applications. The latter consisted only of portland cement concrete pavements. Statistical analysis in the form of regression modeling was applied to the available data and various models/equations and graphic representations developed to predict pavement performance and projected life. The models and graphs were developed using the software packages MINITAB and Microsoft Cricket Graph, respectively.

The models and graphs, pavement life projections, and consolidated data base, will be additional tools or assets available to enable airport planners and managers to manage, budget, and plan more effectively for pavement rehabilitation, replacement, maintenance, and design modifications as needed.

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ACKNOWLEDGMENT

I would like to take this opportunity to thank Professor J. P. Mahoney. His patience, guidance, enthusiasm, and never-ending encouragement were critical to the completion of this research project. His tutelage and empathy for a novice to the pavement field proved invaluable at various stages throughout this project.

Special thanks to Mr. Frederick Mills of WSDOT and Mr. Wade Bryant of the FAA for providing the data necessary to accomplish the analysis needed. Mr. Mills also provided a great opportunity to conduct an on-site PCI survey which lent valuable experience to evaluating the data acquired.

My family's patience, and especially my wife Barbara's understanding during the final weeks of preparation of this report, made a world of difference in completing this major requirement for the Master's degree. Thank you Barbara, Andrew, Ian, and Stephen.

****

ABBREVIATION LEGEND

****

AC - ASPHALT CONCRETE
B - BASE
BS - BITUMINOUS SURFACE
BSB - BITUMINOUS STABILIZED BASE
BST - BITUMINOUS SURFACE TREATMENT
CS - CHIP SEAL
CB - CINDER BASE
DBST - DOUBLE BITUMINOUS SURFACE TREATMENT
E - EMULSION
FS - FOG SEAL
NWF - NON-WOVEN FABRIC
OL - OVERLAY
PFC - POROUS FRICTION COURSE
PRG - PIT RUN GRAVEL
PRB - PIT RUN BASE
PRSB - PIT RUN SUBBASE
SAND S - SAND SEAL
SB - SUBBASE
SC - SEAL COAT
SS - SLURRY SEAL
TBST - TRIPLE BITUMINOUS SURFACE TREATMENT

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Many of our nation's airport managers have, in recent years, begun to realize the importance of an effective pavement management system. An effective and useful system permits managers to anticipate future maintenance and rehabilitation needs by utilizing whatever tools there are available to ensure that the selection of maintenance and rehabilitation strategies provide cost effective solutions to eliminate existing problems. A pavement management system not only evaluates the present condition of a pavement but predicts its future condition through the use of a pavement condition indicator. Pavement systems have evolved over the past two decades, having grown from databases geared towards compiling the amount, type, and condition of pavement within the pavement network to more sophisticated systems that can select future cost effective rehabilitation treatments.

A basic component of any pavement management system is the ability to track a pavement's deterioration and determine the cause of the deterioration. This requires an evaluation process that is objective, systematic and repeatable. A pavement condition rating system that is based on the quantity, severity, and type of distress is a rating of the surface condition of a pavement performance with implications of structural performance [1]. Condition rating data collected periodically will track the performance of a pavement.

Most airports presently utilize the Pavement Condition Index (PCI) rating system developed by the U. S. Army Corps of Engineers (COE) to assess current pavement conditions [1,3]. The Federal Aviation Administration (FAA) established Advisory Circular (AC) 150/5380-6 "Guidelines and Procedures for Maintenance of Airport Pavements" in 1982 [3]. This document outlined the detailed procedures for performing the PCI survey as previously developed by the COE. In short, individual pavement distress types are identified in asphalt and concrete pavements and rated according to severity levels and quantities. The rating is numerical with a range of 0 to 100 which provides a reasonably objective and repeatable indication of the average pavement condition.

The FAA states the following three primary objectives of rating a pavement based on the PCI method:

> (1) Determine present condition of the pavement in terms of the apparent structural integrity and operational surface condition.
>
> (2) Provide the FAA with a common index for comparing the condition and performance of pavements at all airports and also provide a rational basis for justification of pavement rehabilitation projects.
>
> (3) Provide feedback on pavement performance for validation and improvement of current pavement design, evaluation, and maintenance procedures.

Pavement condition surveys can evaluate normal distresses in a pavement structure resulting from surface weathering, fatigue effects, poor drainage, and differential settlement or movement in the subbase over a period of time. PCI surveys evaluate flexible

pavements based on sixteen different types of pavement distress, and rigid pavements based on fifteen types of distress. Chapter 2 will discuss pavement distress in some detail.

1.2 THE PROBLEM

Although PCI surveys are relatively simple, they can be somewhat time consuming depending on the size of the airport, and the amount of air traffic serviced during any given operational day. The problem, however, is not the time associated with conducting the surveys, but the effective and proper use of the data obtained from these surveys. Once the data is collected, it would appear that airports, primarily general aviation airfields may not be privy to the data collected, or how best to utilize the data if it has been made available. As stated previously the PCI is a number which represents the average condition of the pavement. This number establishes a range for a pavement from "very poor" to "excellent". These numbers, however, can be put to greater use to evaluate progressive deterioration of pavements, and further provide a better insight to actual pavement life expectancies compared to original 20-year projections.

The lack of adequate pavement performance models or equations which are needed to predict pavement performance for a variety of uses is the inherent problem regarding the data collected from the surveys previously mentioned. In 1988 a research project conducted by LT Kim Weisenberger, Civil Engineer Corps, U.S. Navy, evaluated statistical data on pavement condition indices of various general aviation runways throughout the northwest tri-state area of Washington, Oregon, and Idaho [1].

After compiling a database, Weisenberger [1] developed pavement performance models, through the use of regression equations, and survival statistics based on a comparison of

pavement features with similar characteristics. The information generated by the research project was only the beginning in terms of PCI data compilation for the northwest's mostly general aviation airports. Although much was accomplished with the information obtained for the research, the conclusion was that much more was needed to strengthen and verify the modeling methodology used.

The regression equations used were intended to assist the FAA and airport managers in determining which northwest airport pavements were in greatest need of maintenance or rehabilitation. These equations could also be of use in the following areas:

a) pavement life estimates
b) relative measures of rehabilitation effectiveness
c) life-cycle costing
d) general design decisions or modifications based on effectiveness
e) planning decisions
f) budget programming

This paper will attempt to take Weisenberger's [1] research a step further due to accomplishment of additional PCI surveys conducted by the Washington Department of Transportation (WSDOT) and the Oregon Department of Transportation (ODOT) in conjunction with the FAA. The same modeling techniques will be used to confirm, as stated previously, the validity of the regression equations and methodology used.

Runway pavements for the state of Idaho will not be addressed as a second set of PCI surveys have not been accomplished to provide updated data on their general aviation airports. These runways are included for age comparisons only in Chapter Three, and preliminary PCI information, pavement structural features, and rehabilitation history are

also attached as Appendix E for further reference. In addition, as in the research project accomplished by Weisenberger [1], only runway pavement conditions will be evaluated.

1.3 SYNOPSIS

This paper will attempt to assess deterioration rates of the airfields common to the research conducted by Weisenberger [1] and that accomplished by this author, after reviewing the initial research and assessing the data collected for comparison by this author. As evidenced by the Pavement Life Cycle curve in Figure 1-1, it is evident that once a pavement has reached 75% of its life expectancy, costs for renovation can increase as much as five-fold. It is the intent of this paper to (1) provide guideline reference models/equations and their corresponding graphic representation that will be useful to an airport manager and their pavement management system, (2) establish that if data collected from the accomplishment of PCI surveys is utilized in the proper fashion, costs for pavement rehabilitation and projected maintenance may be kept to a minimum, and (3) provide a consolidated report of the pertinent and current data to the FAA and all interested parties.

1.4 REPORT OVERVIEW

The objectives stated above will be addressed in a structured manner with Chapter Two highlighting the research methodology adopted for the report analysis and PCI procedures and applications. Chapter Three presents the data categories to be analyzed, a review of the Weisenberger [1] report data, and interpretation of the data used in this report. Analyses and data evaluation, equations development and pavement life calculations, are detailed in Chapter Four. Finally, a report summary including various conclusions and general

recommendations will be presented as Chapter Five. A list of references and report appendices follow the closing chapter.

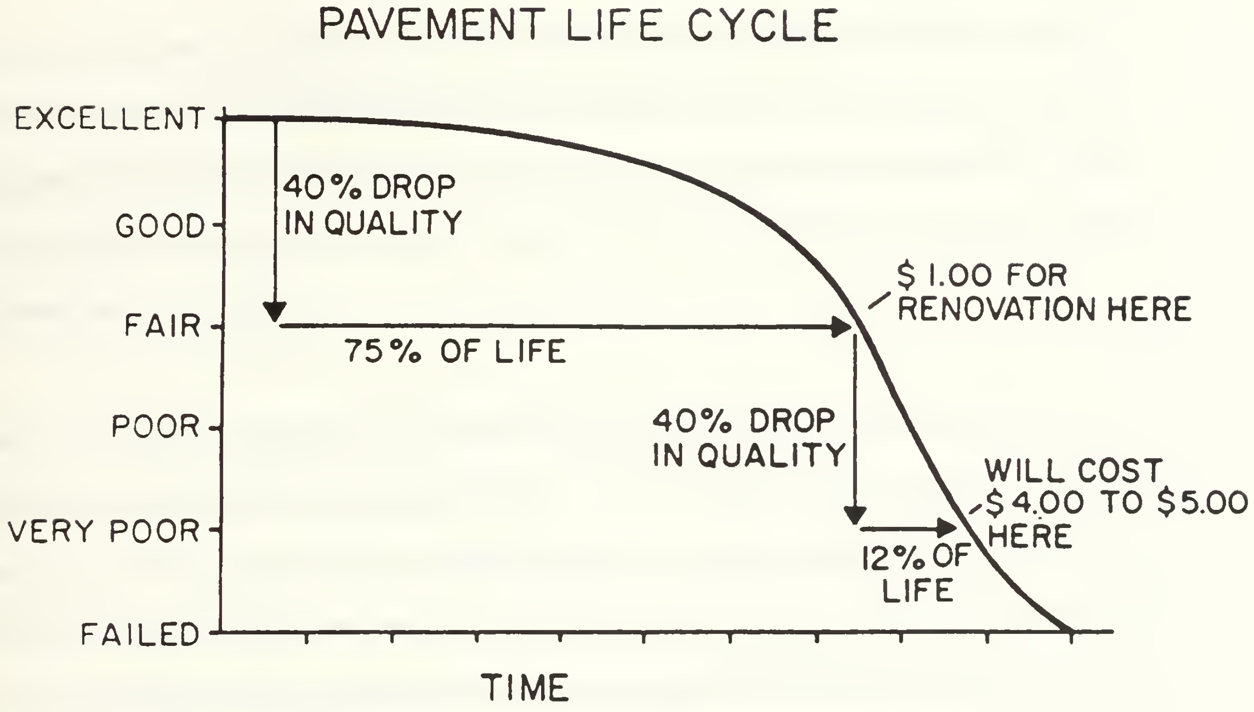


Figure 1-1 Pavement Life Cycle Typical Performance Curve Compared To Maintenance/Replacement Costs [4]

CHAPTER TWO

METHODOLOGY AND PCI APPLICATIONS

2.1 RESEARCH METHODOLOGY

Chapter One stated the primary intent of this report was to develop equations or models that would represent a pavement's behavior and therefore be an asset to an airport manager or planner in the decision making process with respect to their pavement management system. The models provide numerical output that can be used by a planner or manager for future planning and programming.

Since this report consolidates and compiles data from general aviation airports in the tri-state area, correlations among the different types of repairs used, the life of original pavement sections, and in turn the life of various correction methods will be examined. The rate of deterioration between an established point of time "zero" and the first PCI surveys will be compared against deterioration between the first and second points, and the overall deterioration from time "zero" to the second survey points for those runways with three points for evaluation.

Various surface treatment applications and the time elapsed between successive applications will be discussed, and in addition, the age of various pavements based on the application of a surface treatment to an original section of pavement.

The subject matter was evaluated primarily based on the following two objectives:

a) Establish PCI vs AGE curves for all pavements common to the first and second surveys for different thicknesses of flexible and portland cement concrete pavements. The flexible pavements include various thicknesses of AC pavements, AC overlays, bituminous surface treatments, and slurry seal surface maintenance treatments. Applications such as fog seals, chip seals, and emulsions were not common to first and second surveys.

b) Evaluate AGE data for the pavement features being studied. Essentially, an estimation of the projected life expectancy based on past performance of similar pavements will be evaluated.

2.1.1 SUMMARY OF PCI PROCEDURES

Condition Survey Procedure

The procedure is limited to flexible pavements (pavements with conventional bituminous concrete surfaces) and jointed rigid pavements (jointed non-reinforced concrete pavements with joint spacing not exceeding 25 feet).

Objectives:

a. Determine present condition of the pavement in terms of apparent structural integrity and operational safe condition.

b. Provide the FAA with a common index for comparing the condition and performance of pavements at all airports and also provide a rational basis for justification of pavement rehabilitation projects.

c. Provide feedback on pavement performance for validation and improvement of current design, evaluation, and maintenance procedures.

The airport pavement condition survey and the determination of the PCI are the primary means of obtaining and recording vital airport pavement performance data. The condition survey for both rigid and flexible pavement facilities consists primarily of a visual inspection of the pavement surfaces for signs of pavement distress resulting from the influences of aircraft traffic and environment.

Basic Airport Information

Basic airport data is incorporated into the condition survey report.

a. Design/construction/maintenance history.
b. Traffic history - carriers, commuters, cargo, military aircraft traffic records including aircraft type, typical gross loads, and frequency..
c. Climatological data - ranges and precipitation.
d. Airport layout - plans and cross section of major components, including subsurface drainage systems.
e. Frost action - record of pavement behavior during freezing periods and subsequent thaws.
f. Photographs.
g. Pavement condition survey reports.

Outline of Basic Condition Rating Procedure:

1. **Divide pavements into "features" (increments)** - overall airport pavements must be divided into features based on the pavements' design, construction history, and traffic area. A designated pavement feature therefore has consistent structural thickness and materials, was constructed at the same time, and is located on one airport facility, i.e. runway, taxiway, etc.

2. **Divide pavement feature into sample units** - # of slabs or # square feet.

3. **Inspect sample units** - determine distress types and severity levels and measure density.

4. **Determine deduct values** - these are obtained from appropriate curves.

5. **Compute total deduct values (TDV)** - sum all deduct values for each distress condition observed.

6. **Adjust total deduct value** - a corrected deduct value (CDV) is determined using procedures in the appropriate section for jointed rigid or flexible pavements..

7. **Compute pavement condition index** - PCI = 100 - CDV for each sample unit inspected.

8. **Compute PCI of entire feature** - average PCI's of sample units.

The procedure for conducting PCI surveys as stated in Advisory Circular 150/5380-6 has a confidence level of 95 %, however recently the confidence level was reduced to 92% to allow for a smaller inspection area. The confidence level indicates the probability that an obtained value computed from the random sampling survey technique will fall within a 10% range (± 5%) of representing the entire pavement feature being surveyed. The range is now 16 % (±8%).

2.2 PAVEMENT DISTRESSES AND PCI EVALUATIONS

The deterioration of a pavement, runway or highway, is most often readily apparent by external signs or indicators which can be associated with the probable causes of the failure or imperfection. The discussions of problems related to pavement distresses are generally related to the pavement type; concrete or bituminous/flexible [4]. However, while each has its own particular characteristics, the various pavement distress manifestations for bituminous and concrete pavements generally fall into one of the following broad categories [4]:

a) Cracking - often a result of stresses caused by contraction or warping of the pavement in concrete pavements. Overloading, loss of subgrade support, inadequate or improperly cut joints are also possible causes. In bituminous pavements causes are mostly attributed to deflection of the surface over an unstable foundation, shrinkage of the surface, poorly constructed lane joints, or reflection cracking.

b) Distortion - a change in the pavement surface from its original position and results from foundation settlement, expansive soils, frost susceptible soils, or loss of fines through inadequate drainage systems. In bituminous pavements insufficient compaction of pavement courses, unstable bituminous mix, and poor bonding between surface and underlying layers also lead to distortion.

c) Disintegration - improper curing and finishing, unsuitable aggregates, and improper mixing of concrete lead to the breaking up of pavements into small, loose particles. Insufficient compaction of the surface, insufficient asphalt in the mix, or overheating of the mix leads to disintegration in a bituminous pavement.

d) Skid resistance - surface texture reduction and contaminant build-up such as rubber deposit accumulation over a period of time will reduce a pavement's skid resistance. In bituminous pavements, too much asphalt in the mix or too heavy a prime coat will reduce skid resistance.

During the PCI survey procedure, as alluded to previously, sample units are inspected and a determination of the distress types and severity levels is made. Standard distress types can be checked from a listing on the inspection sheet and their severity and density noted.

Severity levels are then assigned "deduct values", totaled, adjusted, and an overall PCI rating obtained by deducting the value for the sample from 100%. See Appendix C pages C-14 and C-17 for the standard forms used in conducting the survey.

2.3 MODELING OBJECTIVES

The correlation and regression modeling equation calculations were accomplished using the statistical software program MINITAB [3], and graphically presented using the Microsoft Cricket Graph software package. Correlation is a means of measuring the association between two variables, whereas regression goes a step further by establishing an equation which determines one of the variables based on knowing the second. The variables are classified as independent and dependent. In the case of this report the independent variable is AGE, and the dependent variable is the corresponding PCI value.

An equation or curve will therefore show the relationship between these two variables over a period of time. There are several important criteria needed in developing reliable pavement models, with each respective criterion capable of significantly altering the model obtained during the evaluation or investigation. The primary criteria are [1,2]:

a) A reliable data base.
b) Include any variable that will significantly affect pavement performance.
c) A usable and functional form of the model.
d) An accurate model which meets statistical requirements.

Modeling attempts to depict the past performance of a particular element based on input data. The data used during the course of this report is simple, however, the PCI values

recorded are based on a pavement's overall condition which incorporates most of the variables associated with a pavement's deterioration including, construction method, materials, construction date, environment, traffic frequency and loading. The models attempted and presented are considered the most applicable based on the constraints, and the above elements apply with the exception of a "variable that will significantly affect the pavement's performance."

2.4 PCI vs. AGE CURVES

As stated earlier in this chapter, the first objective is to develop PCI vs AGE curves for different thicknesses of flexible and rigid pavements. There are varying representations of curve fitting for data being evaluated ranging from a straight line fit to logarithmic curve fit of the data. The straight line fit is represented by an equation that reads as follows : $PCI(\%) = B_0 - B_1(AGE)$. As in the case of any straight line equation, B_0 is the intercept on the PCI (y) axis and B_1 the slope of the line plotted. Based on the fact that a curve best represents the deterioration of a pavement however, other equations involving exponential relationships between the PCI rating and AGE, or polynomial relationships with additional constants and AGE raised to increasing powers best depict the deterioration of a pavement. These equations will be discussed in further detail in Chapter Four.

The following example depicts a typical graph and model that is indicative of the primary objective of this report:

(a) Assume the points indicated in Figure 2-1 represent any pavement section. Two of the possible curves that can be developed to "fit" the four available data points are shown. The initial data point is considered to be PCI = 100, and AGE = 0. This is the assumed value throughout this report for the original pavement construction time frame or where a new surface treatment is applied. The remaining data points are (5,85), (10, 65),

and (15, 30). It is apparent that the curve more readily depicts the rate of deterioration of a pavement versus the straight line depiction. If, for example, failure is considered to have occurred at a PCI of 10%, then the age at failure is 21 years for the straight line fit and 17 years for the curvilinear fit.

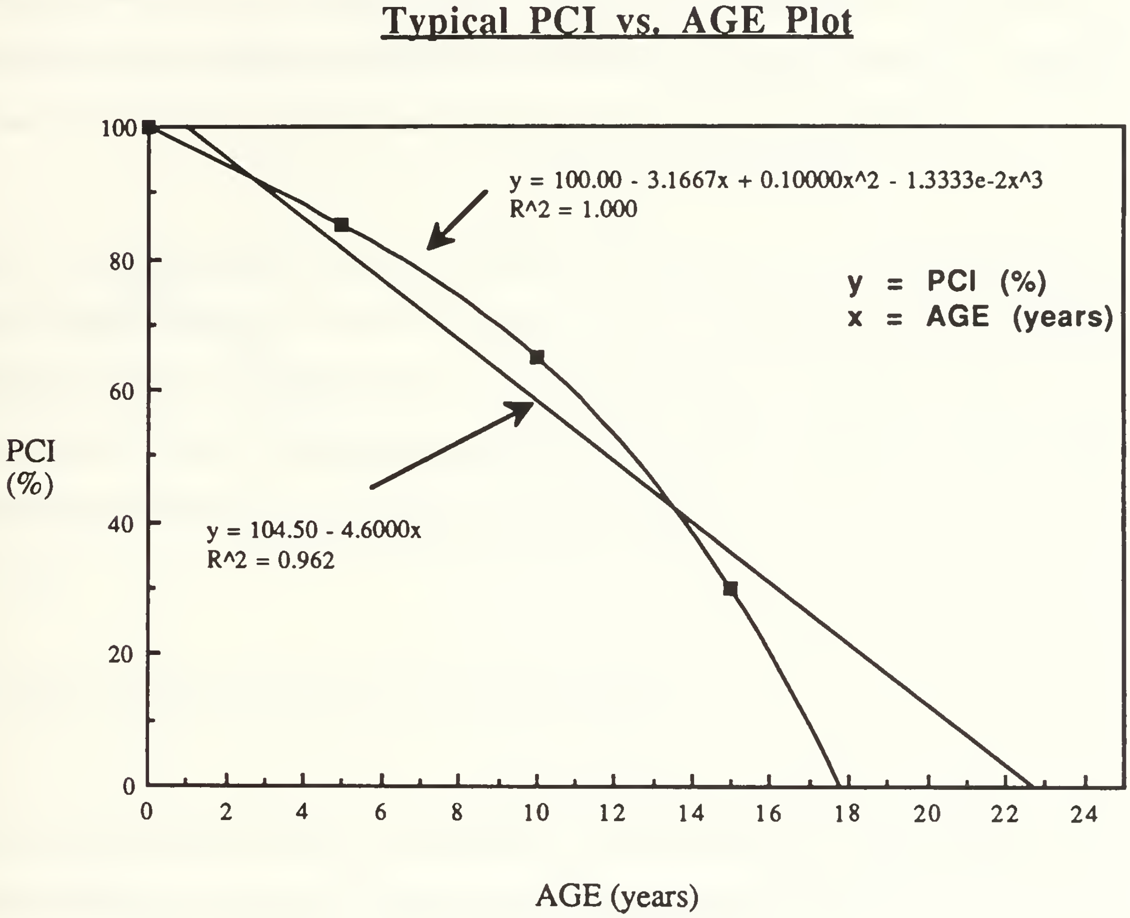


Figure 2-1 Example model of PCI vs AGE for any pavement showing straight line and curvilinear representations.

The R^2 values indicated on the preceding graph will be addressed in Chapter Four.

The second objective of the report is to look at the correlation between pavement structures and estimated LIFE. The time elapsed between original construction of a pavement and a corrective or maintenance application defines the LIFE of that pavement. Regression modeling results can be compared with simple LIFE calculations to determine if a developed model compares favorably or not with results from these calculations. Standard deviation computations will also be used when evaluating pavement LIFE data.

Figure 2-2 depicts typical straight-line performance plots of an AC surface course of two inches asphalt concrete on varying base thicknesses. The correlation of increased base thickness to increased pavement life [1] is apparent from the actual plots shown. An assumption of similar construction materials and processes must also be made when evaluating data results and graphic depictions such as these.

2.5 THE PAVEMENT CONDITION RATING SCALE

The PCI rating scale indicates the respective levels of pavement rated conditions. As shown in Figure 2-3, however, failure of any particular pavement does not occur until a 10% PCI rating has been achieved. Although it was stated previously that 55% is the recommended rehabilitation or replacement point, in fact a pavement is not considered in very poor condition until between 10 and 25%. There is obviously a significant grey area of rating unacceptability which needs to be better defined.

If the scale depicted an established point where the runway pavement was determined to be not usable, then interpretation and subjectivity would become lesser factors in the use of the

the scale. Highways are evaluated using a similar rating method with their scale known as the Pavement Condition Rating (PCR) scale, but there is an implied PCR value of unacceptability at a PCR of 40% [1,8]. This rating is somewhat equal to the PCI 55% rating based on the methods of rating pavements. Figure 2-3 is shown on the following page.

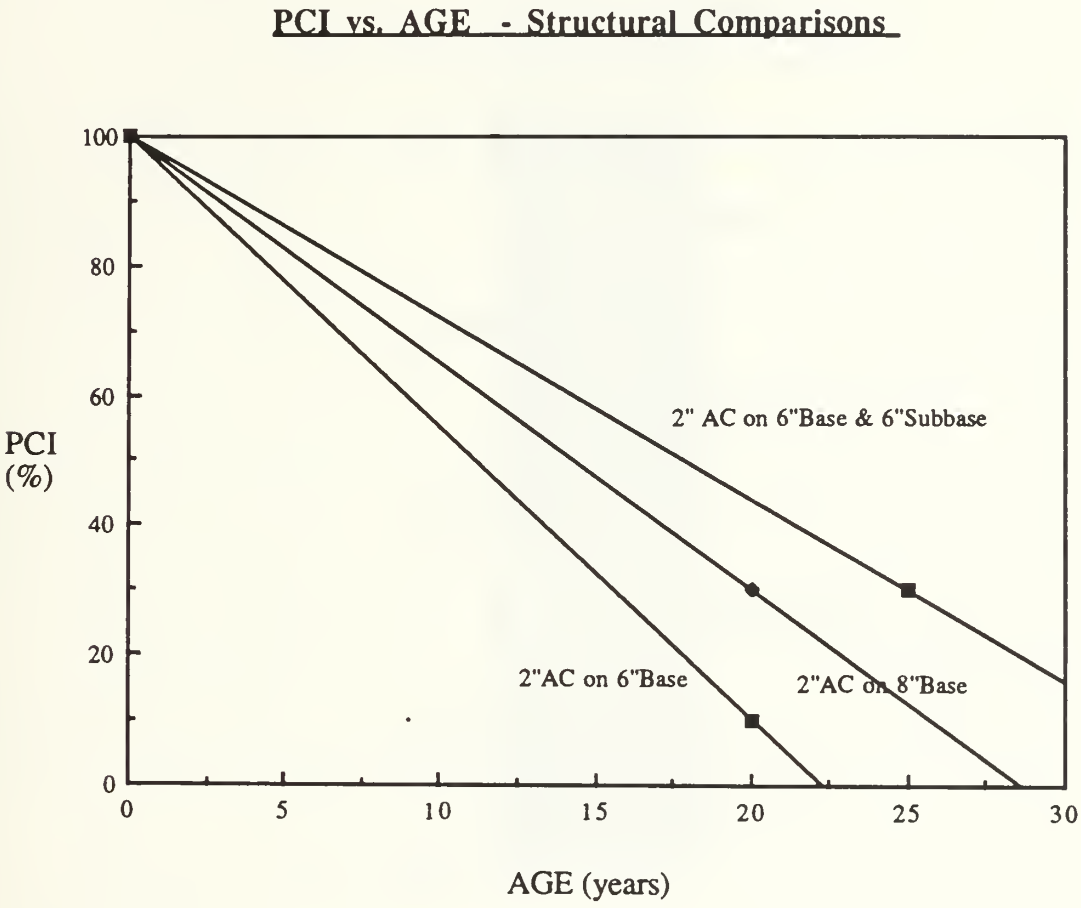


Figure 2-2. Example model of PCI vs AGE for a flexible pavement with constant AC and varying base composition. The equation is PCI = $B_0 - B_1(AGE)$.

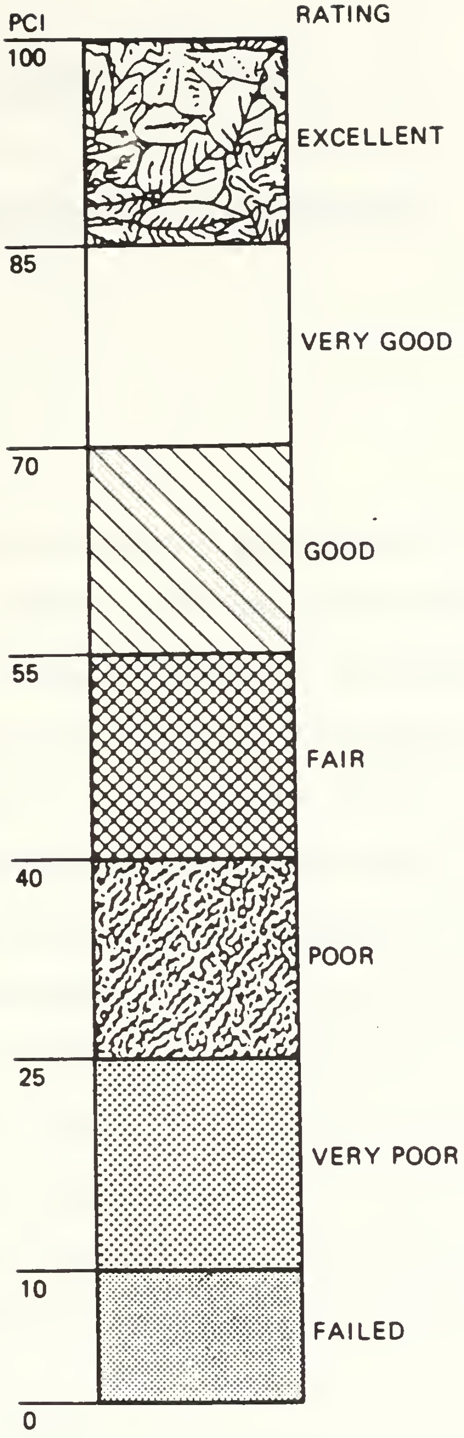


Figure 2-3 Airport Pavement Condition Index (PCI) and Rating Scale [4]

CHAPTER THREE

DATA REVIEW AND INTERPRETATION

3.1 INTRODUCTION

This chapter will present the different categories of data evaluated and an explanation for the particular categories chosen. Substantial information from the report completed by Weisenberger [1] in 1988 was reviewed in addition to current data from the FAA and WSDOT. The information reviewed was incorporated into a database and is attached as Appendices A, B, and E. In addition, actual pavement condition surveys for Othello Municipal, WA and Tillamook Airport, OR are included as example surveys in Appendices A, and B, respectively. As in the case of the first PCI analysis report, written descriptions of airport pavement histories were sometimes sketchy to non-existent. All descriptions were read in detail, however, as evidenced from the data there are still many unknown (UNK) pieces of information for many general aviation airports in the region. Terminology was sometimes inconsistent particularly when the use of bituminous surface treatments (BST's) were discussed. At times one could infer that the inspector or author of the particular survey was referring to a seal coat application versus a BST.

During the first analysis 142 general aviation (GA) airports with 240 different runways were evaluated. The analysis included airports in Washington (64), Oregon (56), and Idaho (22). This report addresses 120 GA airports with 202 runways from Washington and Oregon. Data from Idaho was included for age comparison and reference only. Of the 202 runways, only 78 had a second PCI survey conducted with a reduction in the PCI rating. Other second survey data points were available but not used. Twenty-three points

were higher and in a few cases the same as the first survey three or four years prior. In most cases where there was an increase in PCI rating there was a maintenance application or overlay. In other cases the increased rating is attributable to the individual survey, as no record of a surface treatment between surveys was documented. Other second survey PCI ratings were the same as the first with no deterioration in a three or four year period. The 78 runways therefore provided 156 data points for evaluation, in addition to an assumed PCI = 100 for each data category.

As noted in Chapter Two, PCI ratings are based on pavement distress, however, this analysis will not attempt to tie particular distresses to individual PCI rating results. Appendix C includes examples of various distresses found in runways.

Pavement condition surveys address all facets of an airport's pavement system; runways, taxiways, and parking aprons. This study evaluates PCI values associated only with runways at the GA airports in question. As shown in the surveys for Othello and Tillamook airports, each survey includes the following information:

a) original construction dates
b) maintenance history
c) airport layout
d) sample locations and areas
e) types of pavement distress
f) maintenance recommendations
g) climate data
h) trend conditions
i) feature summaries

It is worthy to note that since PCI surveys are conducted by individuals it is to understand that a certain amount of subjectivity accompanies each inspection despite the training of all inspectors by the same FAA office. Since there is no "subjectivity" factor that can be

applied to the data, readings were accepted at face value and treated as collected, with the exception of points that were simply omitted from the analysis due to no deterioration or an increase in the ratings. These points were discussed earlier. The FAA in fact has reviewed the data and deemed the surveys to be of good quality with no need for adjustments. Other data points omitted from the analysis included those with unknown conditions which placed what information there was on the particular runway or airport in doubt.

3.2 REVIEW OF 1988 DATA

As is the case in this analysis, Weisenberger [1] experienced difficulty with interpreting data during the first PCI study. There were inconsistencies in the data and terminology which still exist. Pavement histories were sketchy and often non-existent all of which created several problems in establishing a credible database.

Similar pavement categories were chosen for this study for easy comparison with those established in the first study. The areas of notable differences occur in the BST's and surface maintenance applications, as the number of data points obtained from second surveys did not warrant a general breakdown of single, double, and triple bituminous surface treatments and only enabled the investigation of slurry seal applications.

Using selected data, Weisenberger [1] was able to generate regression equations and survival statistics. The performance models provided an approximation of how various pavements and maintenance techniques performed. The models were not intended to be used as strict guidelines in assessing an individual pavement, but as an additional tool in evaluating alternatives.

The assembly and compilation of the data indicated that numerous pavements were in need of repair and replacement, even prior to development of the regression models. The report provided a consolidated database of the tri-state area general aviation pavement conditions and presented a good approximation of projected pavement performance and life. A comparison of regression modeling results will be addressed in Chapter Four.

3.3 DATA INTERPRETATION OF 1991 SURVEYS

Some basic and straight forward assumptions were made at the outset when this project was undertaken. All pavements were considered to have a PCI of 100% at original construction or whenever a new surface application was introduced. This assumption can be somewhat tainted by the fact that the construction process could have been faulty or construction materials substandard and therefore nullify the “perfection at the outset” scenario. However, a pavement was considered "satisfactory", PCI = 55% according to the rating scale in Figure 2-3, until the time it received a surface treatment. This elapsed time between construction/surface application and a subsequent maintenance or rehabilitation procedure is considered the life of the pavement. In the case of Tillamook Airport, runway R1 was originally constructed in 1943 with a 2-inch AC surface course. In 1983 a 1.5-inch AC overlay was applied to the runway. This overlay received a PCI rating of 92% in 1987. The LIFE of the pavement was therefore 40 years and the AGE at the survey, 4 years. Other conclusions that can be drawn from the preceding information are:

a) The 1.5” AC overlay is losing 2 % PCI points per year.

b) If one follows the rule of thumb that pavements should be repaired at about a PCI = 55% [4], then the rate of PCI loss during the life of the original surface 2-inch AC is about 1.1% PCI points per year, half the rate of the repair treatment. This assumption of replacement at 55% can be both practical and erroneous since

no record of the PCI rating at rehabilitation of individual pavements is available. At the present rate the AC overlay is predicted to last approximately 22.5 years. The difference in the rates of deterioration can be attributable to a number of factors including construction process or materials, as addressed above.

3.4 PAVEMENT COMPARISONS FOR 1st AND 2nd SURVEYS

As stated previously, the primary objective for this analysis was to look at pavements with two sets of PCI points, actually three counting PCI = 100 at AGE = 0. These individual points would then be grouped into an overall common category and an attempt made to develop a representative model for the data set. Several pavements received surface treatments between surveys and therefore had higher values of PCI compared to their initial rating. Others received higher ratings, but there was no record of a surface treatment applied and therefore the increased rating was attributable to the individual conducting the rating or the lack of proper documentation for the respective pavement. In addition, six pavements were discovered to have the same PCI rating for both surveys; four with a 4-year difference in rating period and two with a 3-year difference in rating period. All of the above mentioned runways were excluded from the overall analysis since the results were not indicative of normal pavement performance.

Further attention was given to the average loss per year for individual pavements between the following points:

a) AGE = 0 and the initial PCI rating
b) PCI rating No. 1 and PCI rating No. 2
c) AGE = 0 and PCI rating No. 2 (overall loss)

This was done in an effort to try and determine the best representative loss rating and thereby assist in determination of LIFE calculations.

3.5 DATA REVIEW

The categories used in the analysis of the data obtained was grouped into five different pavement characteristics, with one the characteristics subdivided in four further groupings. Eight categories of pavements were therefore evaluated and are presented as Tables 3-1 through 3-5. Prior to discussing each of the categories and presentation of the data the following notes are provided:

a) The AGE associated with each PCI rating is the time elapsed between the last surface treatment, whether original or maintenance treated, and the listed PCI survey rating.
b) In tables where only AGE values are given and no "asterisk" accompanies the runway, there were no second survey PCI values available for the runway and as such, a PCI evaluation was not conducted for the runway.
c) The tables indicated in b) are for estimation of that particular pavement feature's overall LIFE.

The five pavement characteristics designated for individual groupings are flexible pavements, AC overlays, bituminous surface treatments, surface maintenance techniques (slurry seals only), and portland cement concrete.

3.5.1 Flexible Pavements - Flexible pavements are normally constructed with a surface course of asphalt concrete, a base course, and depending on design criteria, a subbase course. The base course will normally be composed of a high quality aggregate which can be treated or untreated, crushed or uncrushed, or any combination thereof. If required the subbase would normally be of a lesser quality aggregate than the base. The subdivided categories for flexible pavements are:

a) Two to three inches of AC on six to eight inches of base (Table 3-1a). This category included 12 runways providing 24 data points. Eight runways were from Washington and four from Oregon. The base could be a combination of base and subbase but had to be eight inches or less.

b) Two to three inches of AC on greater than eight inches of base (Table 3-1b). Nine runways with 18 data points were evaluated, with seven from Washington and two from Oregon. The base-subbase composition was irrelevant.

c) Greater than three inches of AC on any base or subbase (Table 3-1c). Five runways with 10 data points were evaluated, with three Washington and two Oregon runways.

d) World War Two constructed AC runways (Table 3-1d). Five runways generated 10 data points to be evaluated and all runways were from Washington.

TABLE 3-1a Flexible pavements with associated PCI survey results and the corresponding AGE for the respective survey (Pavement structural sections consist of 2 - 3 inches AC on 6 - 8 inches of base).

No.	AIRPORT & LOCATION	PCI (%)	AGE (years)	PCI (%)	AGE (years)
1.	BOWERS FIELD, ELLENSBURG, WA (R1)	67	10	64	13
2.	BREMERTON, WA (R5)	82	13	80	17
3.	ELMA MUNICIPAL AP, WA	88	12	83	15
4.	EVERGREEN FIELD, WA (R1)	55	20	51	24
5.	EVERGREEN FIELD (R2)	86	16	77	20
6.	MOSES LAKE, WA (R2)	29	14	18	18
7.	PACKWOOD, WA	94	3	90	6
8.	PORT OF ILWACO, WA	71	15	49	18
9.	ASHLAND, OR (R2)	92	2	88	6
10.	PACIFIC CITY-STATE, 0R	79	37	75	41
11.	SEASIDE STATE, OR	88	23	83	27
12.	TRI-CITY STATE, OR	88	4	77	8

Notes: Where a runway designation is not listed there is only one runway presently at the airport.

All "AGE" listings associated with a PCI value are the ages of the pavement feature when the PCI survey was conducted.

TABLE 3-1b Flexible pavements with associated PCI survey results and the corresponding AGE for the respective survey (Pavement structural sections consist of 2 - 3 inches AC on greater than 8 inches of base).

No.	AIRPORT & LOCATION	PCI (%)	AGE (years)	PCI (%)	AGE (years)
1.	ANACORTES, WA (R2)	95	13	90	16
2.	ANACORTES (R3)	100	13	92	16
3.	AUBURN, WA (R2)	90	19	87	23
4.	EPHRATA, WA (R2B)	89	4	84	8
5.	KELSO-LONGVIEW, WA	90	4	82	8
6.	OLYMPIA, WA (R2)	89	8	85	11
7.	PULLMAN, WA (R2)	70	18	48	21
8.	HOOD RIVER, OR (R1)	96	1	92	5
9.	HOOD RIVER (R2)	95	1	90	5

Notes: Where a runway designation is not listed there is only one runway presently at the airport, or one runway feature of the main runway that was evaluated at the time of the survey.
In certain cases, for example, R2 indicates a separate second runway, however, in others such as Pullman R2, the PCI values are for a specific section of the main runway. Appendices A & B list the differences and show the composition of the pavements for different runways.

TABLE 3-1c Flexible pavements with associated PCI survey results and the corresponding AGE for the respective survey (Pavement structural sections consist of greater than 3 inches AC on any base or subbase).

No.	AIRPORT & LOCATION	PCI (%)	AGE (years)	PCI (%)	AGE (years)
1.	BREMERTON, WA (R2)	83	13	75	17
2.	BREMERTON (R3)	86	13	80	17
3.	PULLMAN, WA (R3)	81	18	68	21
4.	CHRISTMAS VALLEY, OR	90	2	86	6
5.	ILLINOIS VALLEY, OR (R2)	93	27	91	31

Note: Pullman R3 is not a separate third runway.

TABLE 3-1d Flexible pavements with associated PCI survey results and the corresponding AGE for runways constructed during World War Two (No repair or rehabilitation treatment applied).

No.	AIRPORT & LOCATION	PCI (%)	AGE (years)	PCI (%)	AGE (years)
1.	BOWERMAN FIELD, WA (R1)	77	43	59	46
2.	BOWERS FIELD, WA (R4)	54	44	52	47
3.	DEER PARK, WA (R3)	47	43	39	46
4.	OLYMPIA, WA (R1)	55	46	45	49
5.	WINLOCK-TOLEDO, WA	49	43	42	46

Note: Where a runway designation is not listed there is only one runway presently at the airport, or one pavement feature of the main runway that was evaluated at the time of the survey.

Pavement life for runways with flexible pavements constructed during World War Two (WWII), and those constructed after WWII, was examined and data indicated in the following tables. The WWII period is considered between 1942 and 1945.

> a) Post World War Two pavement LIFE (Table 3-1e). The table is separated into two categories for runways with less than three inches of AC, and those greater than three inches AC Thirty one runways are listed with only seven of the runways examined in the PCI analysis.
>
> b) WWII pavement LIFE runway evaluations (Table 3-1f). These comprised 42 runways with 12 of the runways examined in the PCI analysis. They are separated as in the Post-WWII section. As indicated, several airports were in excess of 40 years old before a surface treatment was applied.

For those runways with a corresponding PCI analysis, the Corrective Measure column indicates the category that includes the particular runway for overall analysis. In addition, Appendix D illustrates individual regression modeling for runways being analyzed. The Corrective Measure stated defined the "LIFE" of the respective pavements, and the AC surface course was the original surface course applied to the runway.

TABLE 3-1e Flexible pavement life for pavements constructed after World War II

Pavements with less than 3 inches of original AC surface course

No.	AIRPORT & LOCATION	AC (in)	AGE (years)	CORRECTIVE MEASURE	YEAR
1.	HARVEY FIELD, WA	2	12	SEAL COAT	1982
2.	PANGBORN FIELD, WA (R1)	2	37	CHIP SEAL	1974
3.	PEARSON AIRPARK, WA (R1)*	1.5	9	CHIP SEAL	1975
4.	PEARSON AIRPARK (R2)*	1.5	9	CHIP SEAL	1975
5.	PIERCE COUNTY, WA	1.5	30	REBUILT	1988
6.	PROSSER, WA	2	4	CHIP SEAL	1981
7.	PULLMAN-MOSCOW, WA (R1)*	2	24	2" AC OVERLAY	1972
8.	SEKIU, WA (R1)	2	15	CHIP/SAND SEAL	1987
9.	SEKIU (R2)	2	8	CHIP/SAND SEAL	1987
10.	ALBANY MUNICIPAL, OR	2	27	2"AC OVERLAY	1986
11.	BANDON STATE, OR	2.5	6	CHIP SEAL	1972
12.	CHILOQUIN, OR	1.25	7	SEAL COAT	1968
13.	FLORENCE MUNICIPAL, OR	1.5	17	2"AC OVERLAY	1985
14.	GOLD BEACH, OR	1	19	REBUILT	1983
15.	HERMISTON, OR	1.5	18	2"AC OVERLAY	1977
16.	ROSEBURG, OR*	2	35	SLURRY SEAL	1986
17.	TRI-CITY, OR*	1.5	13	CHIP SEAL	1983
18.	CALDWELL, ID (R1)	2	11	SL./FOG SEAL	1986
19	CALDWELL (R2)	2	11	SL./FOG SEAL	1986
20.	CRAIGMONT, ID	1	8	CHIP/FOG SEAL	1983
21.	GOODING MUNICIPAL, ID	2	7	SLURRY SEAL	1985
22.	NAMPA MUNICIPAL, ID	2	9	SL./FOG SEAL	1985
23.	SODA SPRINGS, ID	2.5	14	SLURRY SEAL	1983

Note: "AGE" in Tables 3-1e and 3-1f is the difference between original construction and the year of the corrective measure. See Appendices A, B & E for complete tabular listings.

TABLE 3-1e Flexible pavement life for pavements constructed after World War II (cont'd)

Pavements with 3 inches or greater of original AC surface course

No.	AIRPORT & LOCATION	AC (in)	AGE (years)	CORRECTIVE MEASURE	YEAR
1.	PANGBORN FIELD (R2)	3	37	CHIP SEAL	1974
2.	PULLMAN-MOSCOW (R2)*	3	17	GROOVED	1985
3.	PULLMAN-MOSCOW (R3)*	4	17	GROOVED	1985
4.	SUNNYSIDE, WA	3	10	SLURRY SEAL	1985
5.	AURORA STATE, OR	3	3	2"AC OVERLAY	1978
6.	ROBERTS FIELD, OR (R1)	4	6	POR. FRIC. CRS.	1981
7.	GRANGEVILLE, ID (R1)	3	18	2" AC OVERLAY	1983
8.	McCALL MUNICIPAL, ID	3	11	SLURRY SEAL	1985

Notes: Where a runway designation is not listed there is only one runway presently at the airport. Idaho runways are included here for comparison with Washington and Oregon state airports with respect to AGE. The former are not included in PCI data comparison or evaluation as there has been no second set of PCI surveys conducted for Idaho airports as of this writing.

* Indicates airports with a second set of PCI surveys which are included in the data analysis and evaluation of this report. Refer to Tables 3-1a through 3-4 and Appendices A, B, and E for PCI and pavement structural section information.

TABLE 3-1f Flexible pavement life for pavements constructed during World War II.

Pavements with less than 3 inches of original AC surface course

No.	AIRPORT & LOCATION	AC (in)	AGE (years)	CORRECTIVE MEASURE	YEAR
1.	BREMERTON NATIONAL, WA (R1)*	2.5	32	3"AC OL	1974
2.	EPHRATA , WA (R2)*	2.5	27	SLURRY SEAL	1970
3.	KENNEWICK VISTA, WA	2	34	CHIP SEAL	1976
4.	OLYMPIA, WA (R3)*	2.5	38	3"AC OL	1980
5.	RICHLAND, WA (R1)	2	36	2"AC OL	1979
6.	RICHLAND (R2)	2	36	2"AC OL	1979
7.	SANDERSON FIELD, WA*	2	37	SLURRY SEAL	1979
8.	WILLIAM R. FAIRCHILD, WA (R1)	2	37	2"AC OL	1979
9.	WILLIAM R. FAIRCHILD (R2)	2	37	2"AC OL	1979
10.	WILLIAM R. FAIRCHILD (R3)	2	36	2"AC OL	1978
11.	BAKER MUNICIPAL, OR (R1)	2.5	21	SEAL COAT	1963
12.	BAKER MUNICIPAL (R2)	2.5	21	SEAL COAT	1963
13.	BOARDMAN, OR	2	37	1.5" AC OL	1980
14.	BURNS MUNICIPAL, OR (R1)	2	36	CHIP SEAL	1978
15.	BURNS (R2)	2	36	CHIP SEAL	1978
16.	CORVALLIS, OR	2.5	42	3" AC OL	1984
17.	LA GRANDE, OR (R2)	2	32	4"AC OL	1974
18.	LAKE COUNTY, OR*	2	42	SLURRY SEAL	1985
19.	MADRAS COUNTY, OR	2	34	2" AC OL	1977
20.	McMINNVILLE MUNICIPAL, OR (R2)	2	37	SLURRY SEAL	1980
21.	NORTH BEND MUNICIPAL, OR (R2)	2.5	34	2" AC OL	1977
22.	NORTH BEND (R2A)	2.25	34	2" AC OL	1977
23.	PENDELTON, MUNICIPAL, OR (R2)	2	32	PFC/7"AC OL	1974
24.	PENDELTON (R3)	2	36	3" AC OL	1978
25.	PENDELTON (R4)	2	36	5.5" AC OL	1978
26	PENDELTON (R5)	2	36	10"AC OL	1978
27.	PORT OF ASTORIA, OR (R2)*	2.5	36	3/4" AC OL	1980

TABLE 3-1f Flexible pavement life for pavements constructed during World War II. (cont'd)

Pavements with less than 3 inches of original AC surface course

No.	AIRPORT & LOCATION	AC (in)	AGE (years)	CORRECTIVE MEASURE	YEAR
28.	SCAPPOOSE INDUSTRIAL, OR	2	43	SLURRY SEAL	1986
29.	NEWPORT MUNICIPAL, OR (R1)	2	40	3" AC OL	1984
30.	NEWPORT (R2)	2	40	SLURRY SEAL	1984
31.	THE DALLES MUNICIPAL, OR (R1)	2.25	22	SLURRY SEAL	1965
32.	TILLAMOOK, OR (R1)	2	40	1.5" AC OL	1983
33.	TILLAMOOK (R2)	2	40	CHIP SEAL	1983

Pavements with 3 inches or greater of original AC surface course

No.	AIRPORT & LOCATION	AC (in)	AGE (years)	CORRECTIVE MEASURE	YEAR
1.	ARLINGTON MUNICIPAL, WA (R2)*	3	34	2"AC OL	1976
2.	BREMERTON NATIONAL (R2)*	3	32	5"AC OL	1974
3.	BREMERTON NATIONAL (R3)*	5	41	CRACK SEAL	1983
4.	BREMERTON NATIONAL (R4)*	3	32	2"AC OL	1974
5.	EPHRATA (R1A)*	3	27	SLURRY SEAL	1970
6.	OMAK, WA*	4.5	31	2.5" AC OL	1974
7.	NORTH BEND, OR (R1)	3	34	2" AC OL	1977
8.	NORTH BEND (R3)	3	9	CHIP SEAL	1952
9.	PENDELTON (R1)	3	32	PFC/7" AC OL	1974

Notes: Where a runway designation is not listed there is only one runway presently at the airport.

* Indicates airports with a second set of PCI surveys which are included in the data analysis and evaluation of this report. Refer to Tables 3-2 through 3-4 and Appendices A, B, and E for PCI and pavement structural section information.

3.5.2 AC Overlays - AC overlays considered for this category of the analysis ranged from 3/4 inch to 3 inches, with the majority of the runways receiving a 2 inch overlay as a rehabilitation measure. Eighteen runways were evaluated (36 points) with only six receiving less than a 2 inch overlay. Twelve of the 18 runways were Washington, and the remaining six are Oregon runways. Of the corrective measures analyzed for this study, AC overlays were easily the most commonly used. Table 3-2 lists the PCI ratings at the corresponding pavement AGE and AC overlay thickness.

Asphalt concrete overlays are used as a means of rehabilitating existing pavements [1,5]. They restore the existing pavement's surface characteristics and improve its structural integrity. The thickness of an AC overlay is determined by the intended use and can vary from approximately 1 inch, and sometimes less*, to several inches [5]. The most common thickness used is normally 2 inches. The AC overlays were examined as a single pavement feature with all thicknesses grouped together.

* The Port of Astoria's runways R1 and R1A each have 3/4-inch AC overlay surface courses.

TABLE 3-2 Flexible pavement AC overlays with associated PCI results and corresponding AGE

No.	AIRPORT & LOCATION	OL (in)	PCI (%)	AGE (years)	PCI (%)	AGE (years)
1.	ANACORTES, WA (R1)	2	96	13	91	16
2.	ARLINGTON, WA (R2)	2	89	10	84	13
3.	BREMERTON, WA (R4)	2	88	13	83	17
4.	CREST, WA	2	97	1	90	5
5.	MOSES LAKE, WA (R1)	2	89	3	81	7
6.	OLYMPIA, WA (R3)	3	86	8	84	11
7.	OMAK, WA	2.5	68	12	65	15
8.	OTHELLO, WA	2	79	11	74	15
9.	PORT OF WILLIPA HARBOR, WA (R1)	1	72	10	58	13
10.	PORT OF WILLIPA HARBOR (R2)	1.25	68	10	59	13
11.	PULLMAN-MOSCOW REGIONAL, WA (R1)	2	75	14	70	17
12.	WILBUR, WA	2	92	1	83	4
13.	ASHLAND, OR (R1)	2	91	1	89	5
14.	ILLINOIS VALLEY, OR (R1)	2	87	10	83	14
15.	PINEHURST, OR	1	83	2	76	6
16.	PORT OF ASTORIA, OR (R1)	3/4	87	7	79	11
17.	PORT OF ASTORIA (R1A)	3/4	77	7	68	11
18.	TILLAMOOK, OR (R1)	1.5	92	4	89	8

Note: Where a runway designation is not listed there is only one runway presently at the airport.

"AGE" is the difference between the year of original construction of the overlay and the year the PCI survey was conducted. Refer to Appendices A and B for PCI survey dates.

3.5.3 Bituminous Surface Treatments (BST) - Bituminous surface treatments are different from asphalt concrete in that they do very little to enhance a pavement's ability to support loads [6]. The surface treatment is normally less than 1 inch in thickness and consists of a thin layer of bituminous binder containing surface course aggregate [5]. This layer is normally placed on an aggregate base. These applications are most often used as a wearing and waterproofing surface course [1]. BST's are usually applied for maintenance purposes which includes use as a seal coat on previously treated surfaces. This particular difference caused some problems in the case of the first report because of the use of terminology in the PCI surveys, i.e. seal coat versus BST.

Nine runways were analyzed with no distinction regarding whether the surface course was a single bituminous layer, double, or triple treatment. It should be noted that a DBST does not always mean two single BST layers, and similarly a TBST does not mean necessarily that three single BST layers are present. The difference relates to multiple equivalent layers as opposed gradually increasing aggregate size layers. Table 3-3a lists PCI and AGE results for the 9 runways, 18 points, and Table 3-3b provides LIFE data for those pavements which received surface treatments prior to the two PCI surveys. Only one of the runways was from Oregon.

TABLE 3-3a Bituminous surface treatments with associated PCI results and corresponding AGE. ("AGE" indicated is time elapsed between last surface treatment and survey.) (See Appendices A and B for years of survey for the respective runways.)

No.	AIRPORT & LOCATION	BST COMP.	PCI (%)	AGE (years)	PCI (%)	AGE (years)
1.	CONCRETE MUNICIPAL, WA	DBST	61	12	34	15
2.	DAVENPORT, WA	TBST	82	2	60	5
3.	OCEAN SHORES, WA	DBST	98	1	95	4
4.	ODESSA, WA (R1)	DBST	79	2	46	6
5.	ODESSA (R1A)	TBST	58	2	50	6
6.	SEQUIM VALLEY, WA	DBST	52	3	42	6
7.	STORM FIELD, WA	TBST	73	1	68	4
8.	WOODLAND STATE, WA	TBST	91	3	88	7
9.	NEWHALAM BAY, OR	TBST	80	8	77	12

Note: BST's include both original construction and maintenance ("seal coats")

TABLE 3-3b Bituminous surface treatments LIFE data.

No.	AIRPORT & LOCATION	BST COMP.	SURFACE COURSE	BASE (inches)	AGE (years)
1.	CONCRETE MUNICIPAL, WA	DBST	DBST (OS)	6	NR
2.	DAVENPORT, WA	TBST	BST-DBST	8	11
3.	OCEAN SHORES, WA	DBST	DBST (OS)	8	NR
4.	ODESSA, WA (R1)	DBST	DBST	6	15*
5.	ODESSA (R1A)	TBST	DBST-BST	3	15
6.	SEQUIM VALLEY, WA	DBST	DBST (OS)	12	NR
7.	STORM FIELD, WA	TBST	BST-DBST	8	17
8.	WOODLAND STATE, WA	TBST	TBST (OS)	?	NR
9.	NEWHALAM BAY, OR	TBST	BST-DBST	6	14

Notes: Where a runway designation is not listed there is only one runway presently at the airport.
OS - original surface NR - no repair/rehab * - reconstructed

3.5.4 Surface Maintenance Applications & Techniques - The only surface maintenance technique evaluated in this study, was the category of slurry seals, as this treatment was the only one present in runways with two sets of PCI surveys. Surface maintenance applications are normally sprayed asphalt treatments and are a repair measure rather than a structural enhancement method. Waterproofing and improvement of skid resistance are two of the primary uses of these applications [1]. The first analysis had six groupings of surface seal applications, but as noted above only slurry seal maintenance will be addressed here. This was not considered a problem since it is the most common repair method. Slurry seals are a mixture of well-graded fine aggregate, mineral filler, emulsified asphalt, and water applied to a pavement as a surface treatment.

Of the airports evaluated, none have received a subsequent treatment, therefore maintenance technique LIFE investigations were not possible. Eleven runways with 22 PCI/AGE points were analyzed. Eight of the 11 runways were from Washington.

Weisenberger's [1] study addressed surface treatment LIFE evaluations for various applications, however, the data make-up and groupings will not be restated here. Findings from the analysis of the data will be summarized for reference in Chapter Four.

TABLE 3-4 Slurry seal surface maintenance applications with PCI results and corresponding AGE. (Age listed is time elapsed since initial surface treatment).

No.	AIRPORT & LOCATION	PCI (%)	AGE (years)	PCI (%)	AGE (years)
1.	EPHRATA MUNICIPAL, WA (R1A)	60	17	55	21
2.	EPHRATA MUNICIPAL (R2)	53	17	43	21
3.	PRU FIELD, WA	83	2	77	6
4.	QUINCY, WA (R1)	72	7	70	11
5.	ROSALIA MUNICIPAL, WA	68	2	49	6
6.	SAND CANYON (CHEWELAH), WA	88	12	70	15
7.	SANDERSON FIELD, WA	77	9	72	12
8.	WHITMAN COUNTY MEMORIAL, WA	57	5	40	8
9.	LAKE COUNTY, OR	71	2	68	6
10.	ROSEBURG MUNICIPAL, OR	77	1	57	5
11.	SCAPPOOSE INDUSTRIAL, OR	65	1	64	5

Note: Where a runway designation is not listed there is only one runway presently at the airport.

3.5.5 Portland Cement Concrete (PCC) Pavements - Eight PCC pavements with sixteen data points were analyzed, and as indicated by the data, only Condon State Airport was constructed after WWII. The runway is also the only Oregon pavement represented in the data. Three of the runways are in poor shape whereas two are in very good to excellent shape. It is interesting to note that the runway at Condon State is the newest of the airports yet it has experienced the most severe deterioration rate (4% PCI loss per year since the first PCI survey). At this rate, significant rehabilitation will be required in another six or seven years, which is almost unacceptable since the pavement life would be a mere 11 years. No record of any maintenance or repair for Bowerman Field R2 or Chehalis-Centralia R1 was found. Table 3-5 lists the pertinent information for this category.

TABLE 3-5 Portland cement concrete pavement PCI results and corresponding AGE.

No.	AIRPORT & LOCATION	PCI (%)	AGE (years)	PCI (%)	AGE (years)
1.	BOWERMAN FIELD, WA (R2)	86	43	84	46
2.	BOWERMAN FIELD (R3)	33	43	26	46
3.	CHEHALIS-CENTRALIA, WA (R1)	84	45	81	49
4.	CHEHALIS-CENTRALIA (R2)	78	45	67	49
5.	EPHRATA, WA (R1)	40	44	33	48
6.	EPHRATA (R2A)	47	44	26	48
7.	QUILLAYUTE, WA	72	44*	69	47*
8.	CONDON STATE, OR	94	1	78	5

* An original construction date for Quillayute could not be determined, but based on various record information the assumed date of construction was set at 1942.

Note: Where a runway designation is not listed there is only one runway presently at the airport.

CHAPTER FOUR

ANALYSIS AND RESULTS

4.1 ANALYSIS INTRODUCTION

The primary analysis in this paper is based on regression modeling. Physical hand calculations were not required with the exception of simple average computations for the average deterioration of various pavements and AGE or LIFE calculations. Reference material and subsequently the use of software packages were the means to the development of these models/equations. The WSDOT study entitled "Regression Analysis for WSDOT Material Applications" [2], and "Prediction Models and Performance Curves" [10], from a Federal Highway Administration short-course were the two primary reference items used during the accomplishment of this analysis and report.

4.2 REGRESSION MODELING

The regression modeling techniques used in this analysis are not recommended to be strict applications for predicting pavement performance. Rather, they are intended to be used as guidelines in assessing individual pavement performance against a select grouping or groupings of pavement. The equations developed and graphic plots depicted are intended to be additional tools in helping an airport manager more effectively use information and assets on hand to better plan and budget the pavement management system respective to the

airport needs. The limited data for analysis restricts the use of the models in any other manner.

4.2.1 Regression Models - Simple linear and non-linear regression analysis were the two methods of analysis applied to the available data . Simple linear regression provides a straight "best-fit" representation and non-linear provides a curvilinear depiction through the use of exponential, polynomial, or logarithmic functions. In the case of this study, both exponential and polynomial applications were used, however, in all cases the polynomial application provided what appeared to be the best curve fit. The two variables which are used throughout the analysis are PCI rating and AGE, with the former being the dependent variable and the latter, the independent variable. The modeling is considered "simple" since only one independent variable exists, with the exception of polynomials, and in the case of the simple linear regression where the equation used is normally PCI = B_0 - B_1(AGE), the equation is linear since both parameters (B_0, B_1) and the independent variable (AGE) are not power functions. A non-linear model is one where the regression parameters appear as exponents or where the independent variable(s) appear as second order or higher powers [10].

The regression parameters (B_0, B_1) are commonly referred to as regression coefficients, and, as stated in Chapter Two, B_0 represents the intercept of the regression line and B_1 the slope of the regression line in a linear equation. Polynomial equations depict more than one independent variable, however, each subsequent variable is a power function of the original independent variable. The following equation indicates this relationship:

$$PCI = B_0 + B_1(AGE) + B_2(AGE)^2 ...... + B_n(AGE)^n$$

The use of polynomials is restricted in that an attempt should always be made to use the lowest degree polynomial equation to obtain the "best fit" possible.

The preferred method of regression analysis by WSDOT is the exponential form of the standard regression equations where the "power" is fixed, then the regression coefficients are determined based on available data points [10]. WSDOT uses this application in their Pavement Management System by selecting various powers until the best fit is obtained. The equation reads as follows:

$$PCR = B_0 + B_1(AGE)^n \qquad \text{(where "n" is the selected power)}$$

Normally the power ranges from 1.0 to 3.0, and results are analyzed in 0.25 increments.

The generation of regression equations is accompanied by factors which give an indication of the reliability or confidence associated with the equation resulting from analysis of the data. The following is a list of the factors and their relationship to the data:

a) R-Squared - R-squared is the coefficient of determination and used to explain how much the total variation in the data is explained by the regression line [2]. This value is expressed as a percent, therefore if all points fall on the regression line the R-squared value is 100% whereas if the point are a significant distance away from the regression line the value will also decrease significantly. The higher the R-squared the more confidence is provided regarding the data and the line chosen to best fit this data.

b) T-Ratio - The T-ratio is the result of a hypothesis test which determines how well the independent variable predicts the dependent variable. The T-ratio should generally be greater than 2.0 for each independent variable to be a relatively strong predictor for the dependent variable [11].

c) SEE - The SEE value is the standard error of the estimate [11]. This value is used to estimate the standard deviation of the dependent variable about the regression line and is in the units of the dependent variable. Smaller SEE values for an equation indicate better reliability.

The MINITAB software used in the analyses provides the values of R-squared, T-ratio, and SEE in addition to the regression equation.

4.2.2 Regression Assumptions - The primary assumption used throughout the analysis of the pavement categories is that the PCI rating at construction or surface treatment is equal to 100%. This therefore facilitated the use of PCI = 100 at AGE = 0 for each set of data points used to describe overall pavement condition. The assumption was also used with the individual runway data when developing single regression equations. The assumption was applied to new construction, reconstruction, AC overlays, and also to slurry seals for this study. In the case of slurry seals, evaluations were conducted for both cases, with the first category evaluated as stated above, and the second assuming PCI was not equal to 100% at AGE = 0. From the analysis it was evident that the latter assumption was more realistic.

4.2.3 Regression Equation Development - The above stated assumption is instrumental as it provided a third data point in the case of individual runway model or equation development. and an initial data point for each pavement category. In the case of the initial study conducted by Weisenberger [1], an evaluation of the data without the initial data point of PCI = 100 and AGE = 0 in various models, revealed essentially the same equation results with slight differences in the R-squared, T-ratio and PCI (y) intercept. This assumption, however, could be criticized as it implies perfection at the outset or upon corrective applications. This is especially inconsistent in the case of seal coat applications because of the range of quality applications and materials in the field. The data to some extent illustrates this point with some runways already in "fair" and "good" shape after only a year, whereas a few are in "very good" and "excellent" shape after seven and up to twelve years.

The critical decision in conducting the analysis was the choice between the use of the polynomial regression and exponential regression relationships outlined in section 4.2.1. The same process of selection of powers for the best curve fit was applied in the use of polynomial equations with the Microsoft Cricket Graph software. This procedure provided a somewhat comparable curve to the normal expected representation of a pavement's performance.

The data was compared from both standpoints in that exponential regression modeling was accomplished using the MINITAB software and polynomial regression modeling was done with Cricket Graph. Comparisons and an assessment of each set of findings will be discussed in each category. The Cricket Graph software did not however provide T-ratio and SEE values for comparison with the MINITAB analyses. In addition, during the course of analysis certain data point "sets", two PCI survey readings for a runway, were intentionally omitted when presenting the final plot of the best fit curve. This was done in cases where the set provided a significant influence on the outcome of the regression model. In these cases unreported maintenance on the runway surface, construction quality, or poor materials used could have influenced the PCI results for the corresponding AGE of the pavement. The data is shown on the graph but when the "best" representative curve was selected, the high influence data or sets of points which did not appear to be indicative of normal pavement behavior, did not determine the model outcome. It will be very evident from the illustrations which data points were omitted in the development of the final model.

4.3 REGRESSION ANALYSIS AND RESULTS

The following sections provide the results and accompanying pertinent assumptions or modifications relative to the category being analyzed The regression equation listed is per the procedure listed in the preceding section. Where data points have been intentionally

omitted, special graph points will be shown to distinguish them from the points used for the final equation. The category sequence is as presented in Chapter Three and is restated here for quick reference.

Flexible pavements ranging from AC surface course original construction to bituminous surface treatments were evaluated for this report. Slurry seals were the only surface maintenance applications analyzed and for rigid pavements, portland cement concrete was the only runway of choice. Below is the category arrangement for the pavement sections:

a) Flexible Pavements	4.3.1
b) AC Overlays	4.3.2
c) Bituminous Surface Treatments	4.3.3
d) Slurry Seal Surface Treatments	4.3.4
e) Portland Cement Concrete	4.3.5

4.3.1 Flexible Pavements - The data for flexible pavements was separated into four categories for performance evaluation using regression analysis. Three of the four were based on thickness, and the fourth was restricted to World War Two (WWII) pavement analysis. Two categories were used in evaluating flexible pavement LIFE, WWII constructed runways and post WWII runways.

4.3.1.1 Regression Models - Tables 4-1a through 4-1d list the regression analysis results obtained for the flexible pavement categories evaluated in this section.

TABLE 4-1a Regression equations for flexible pavement structural sections consisting of 2 - 3 inches AC on 6 - 8 inches of base.

(1)

(With "high influence points")

WASHINGTON
PCI = 99.1 - 2.14(AGE)
t-ratio = 2.78
R-sq = 34.0%
SEE = 19.2
N = 17

OREGON
PCI = 91.5 - 0.361(AGE)
t-ratio = 2.73
R-sq = 51.6%
SEE = 5.89
N = 9

COMBINED
PCI = 82.0 - 0.486(AGE)
t-ratio = 1.13
R-sq = 5.3%
SEE = 20.01
N = 25

CRICKET GRAPH RESULTS
PCI = 99.11 - 2.14(AGE) WA
R-sq = 34.0% N = 17

PCI = 91.48 - 0.361(AGE) OR
R-sq = 51.6% N = 9

PCI = 83.07 - 0.583(AGE) Comb.
R-sq = 8.5%

Note: "N" is the number of data points used.

(2)

(Without "high influence points")

WASHINGTON
PCI = 91.7 - .072$(AGE)^2$
t-ratio = 3.84
R-sq = 53.1%
SEE = 11.2
N = 15

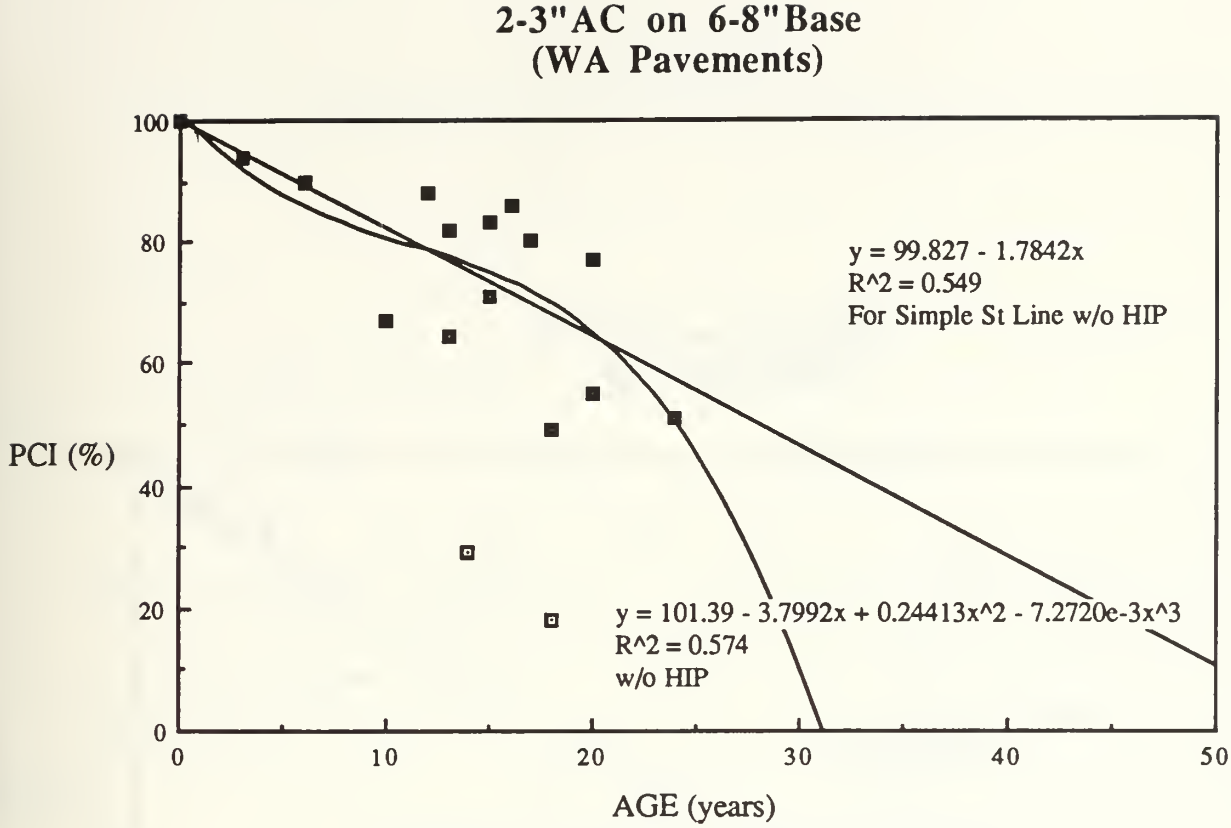
OREGON
Same

COMBINED
PCI = 99.2 - 1.99(AGE)
t-ratio = 2.57
R-sq = 28%
SEE = 19.65
N = 21

CRICKET GRAPH RESULTS
PCI = 99.83 - 1.78(AGE) WA
R-sq = 54.9%

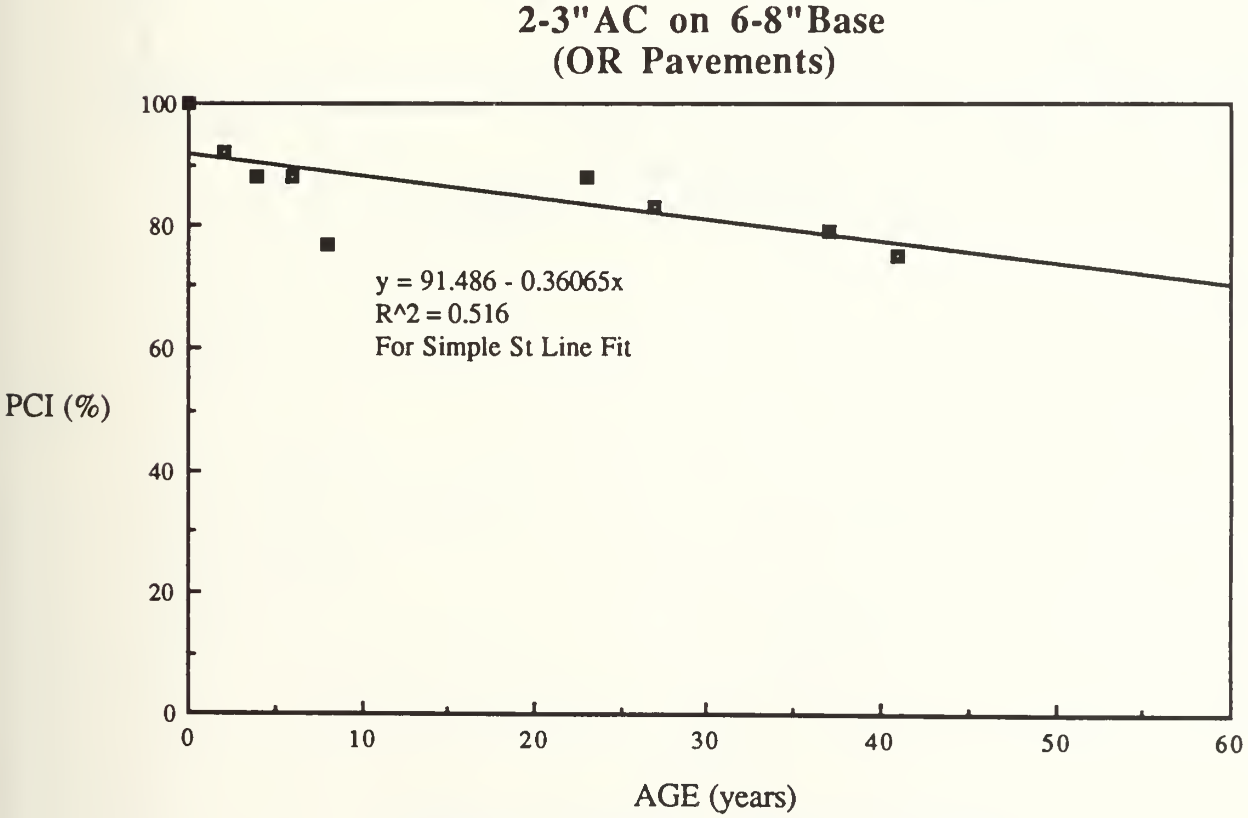
PCI = 97.9 - 2.07(AGE) Combined
R-sq = 40.8%

High Influence Point - HIP



2-3"AC on 6-8"Base (WA Pavements)

Figure 4-1a WA PCI vs AGE For 8 Runways Showing Plots Without High Influence Pts



2-3"AC on 6-8"Base (OR Pavements)

Figure 4-1b OR PCI vs AGE For 4 Runways

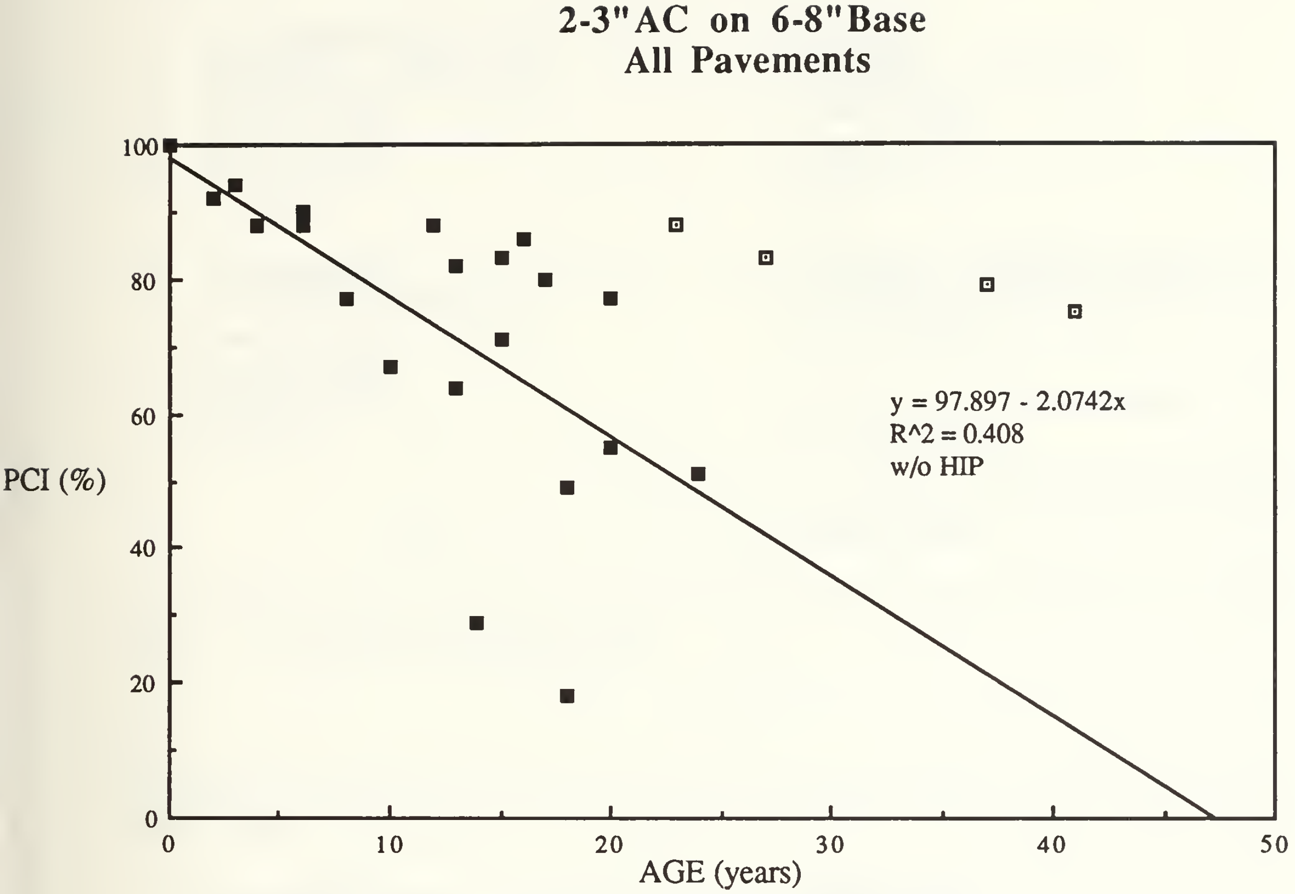


Figure 4-1c Combined PCI vs AGE

TABLE 4-1b Regression equations for flexible pavement structural sections consisting of 2 - 3 inches AC on greater than 8 inches of base/subbase.

(1)

(With HIP's)

WASHINGTON
PCI = 96.4 - 0.853(AGE)
t-ratio = 1.82
R-sq = 20.3%
SEE = 11.87
N = 15

OREGON
PCI = 98.1 - 1.47(AGE)
t-ratio = 4.15
R-sq = 85.2%
SEE = 1.71
N = 5

COMBINED
PCI = 96.1 - 0.838(AGE)
t-ratio = 2.45
R-sq = 26.1%
SEE = 10.39
N = 19

CRICKET GRAPH RESULTS
PCI = 96.4 - 0.853(AGE) WA
R-sq = 20.3%

PCI = 98.1 - 1.47(AGE) OR
R-sq = 85.2%

PCI = 96.1 - 0.838(AGE) Combined
R-sq = 26.1%

Note: "N" is number of data points used.

(2)

(Without HIP's)

WASHINGTON

$PCI = 91.1 - .036(AGE)^2$
t-ratio = 1.9
R-sq = 24.7
SEE = 11.81
N = 13

OREGON

Same

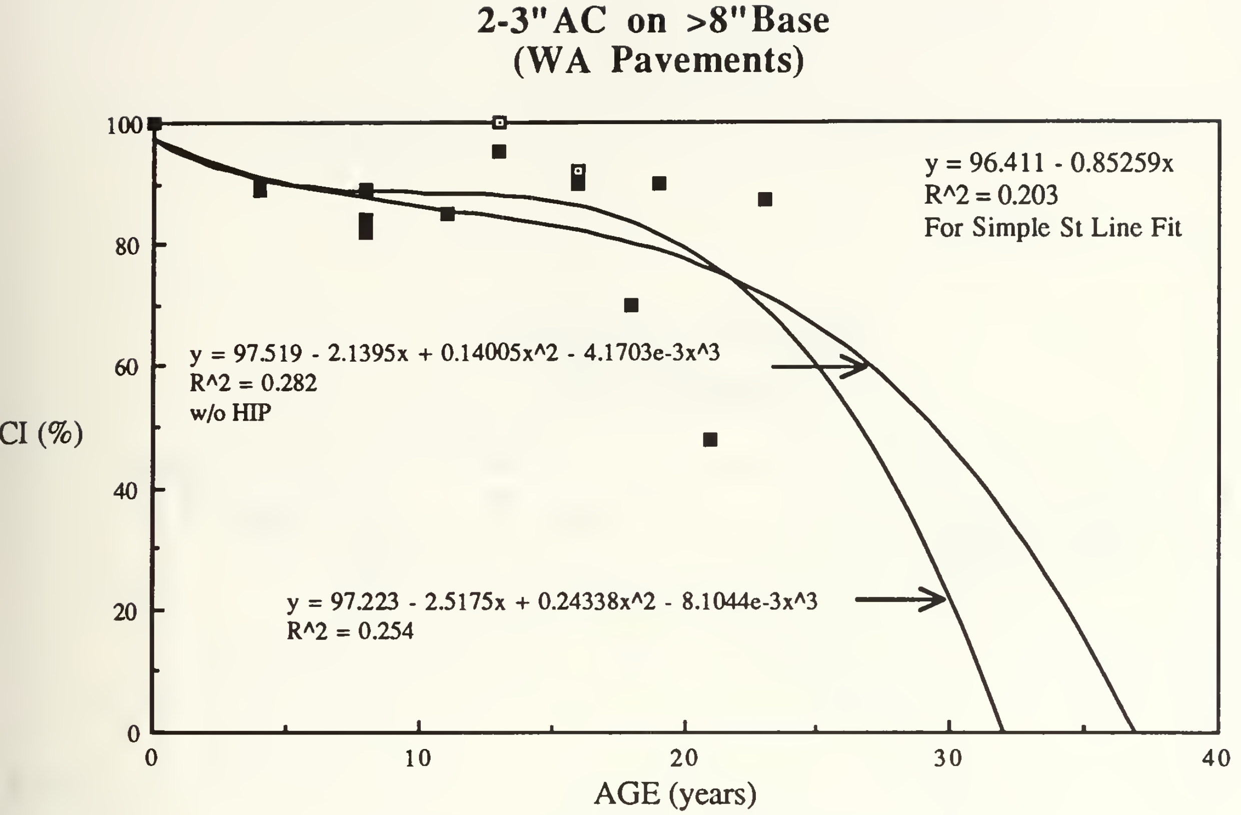
COMBINED

$PCI = 93.6 - 0.19(AGE)^{1.5}$
t-ratio = 2.78
R-sq = 34%
SEE = 10.04
N = 17

CRICKET GRAPH RESULTS

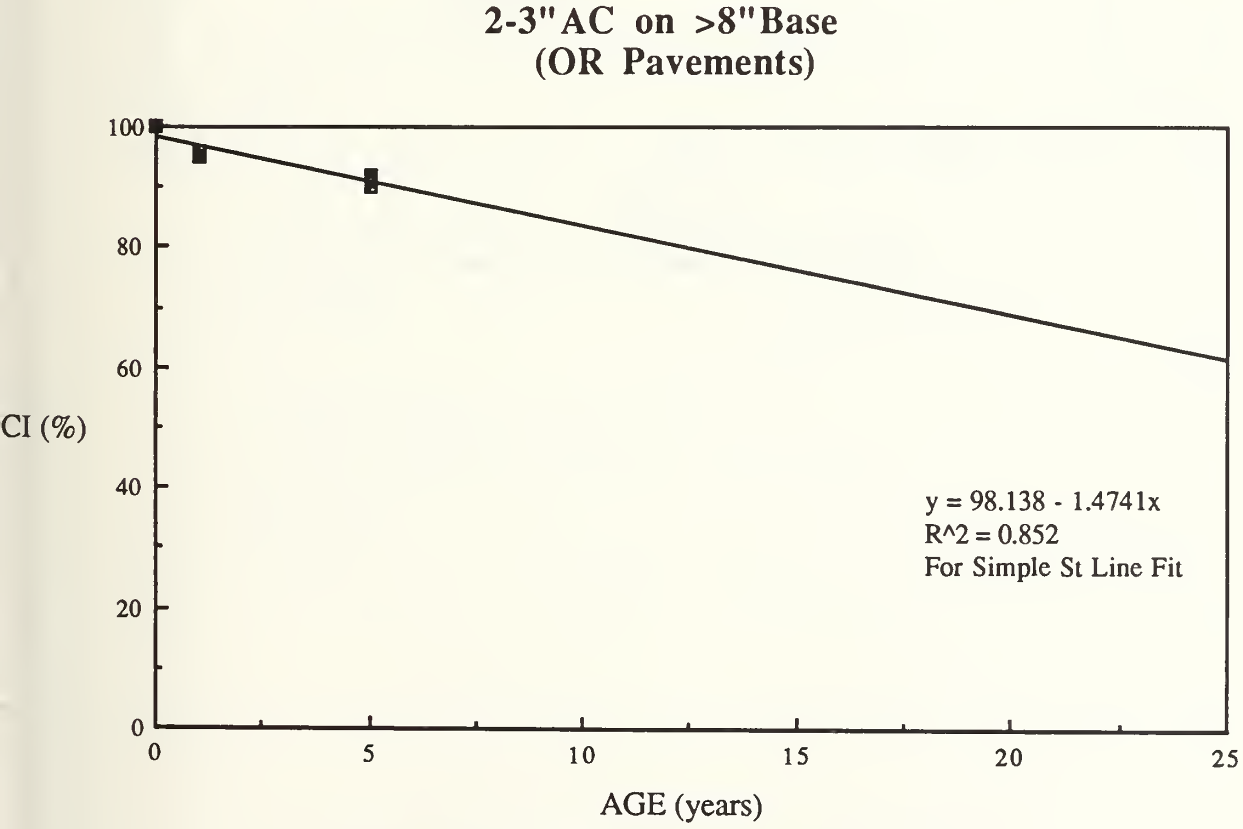
See Polynomial Fit Fig. 4-2a of WA
For Equation R-sq = 28.2%

See Fig 4-2c For Combined Fit
& Equation R-sq = 36%



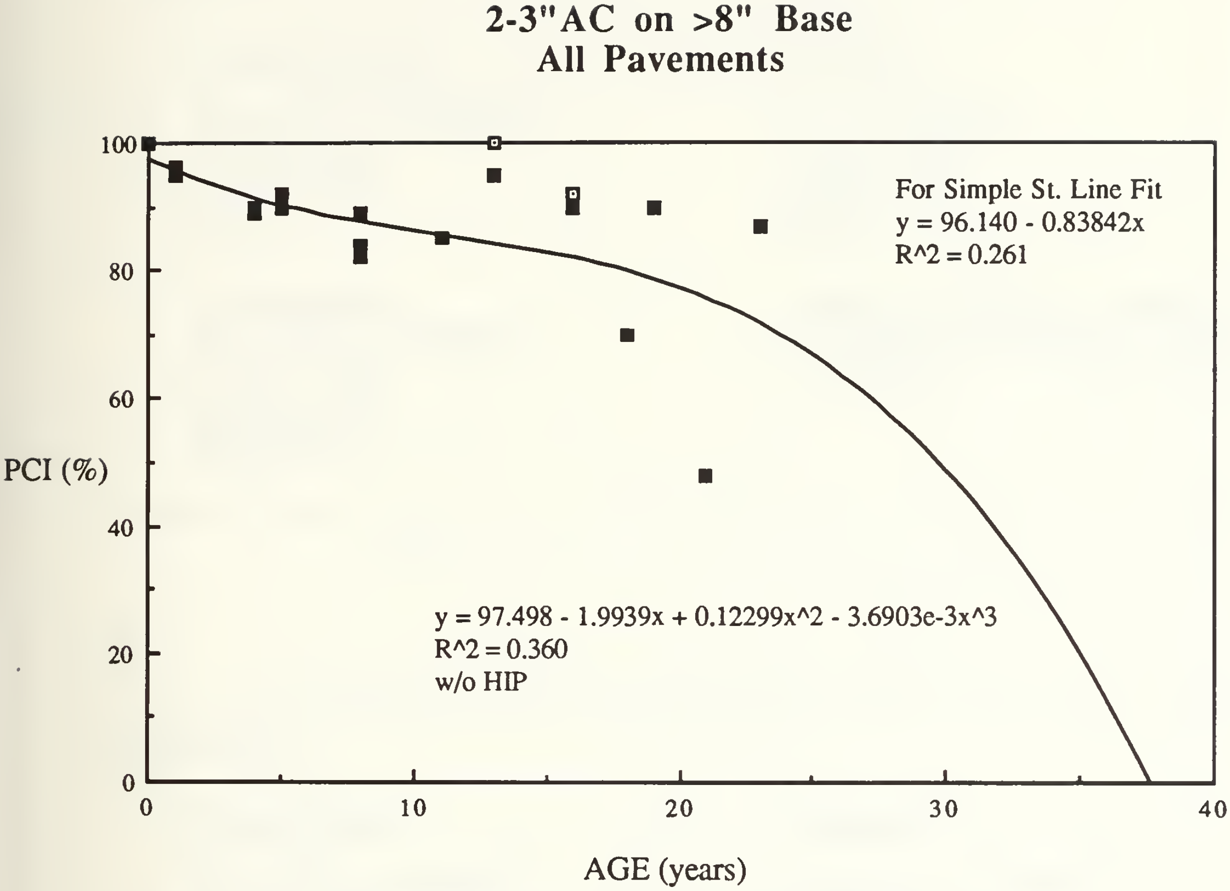
2-3"AC on >8"Base
(WA Pavements)

Figure 4-2a WA PCI vs AGE For 7 Runways Shown With & Without High Influence Pts



2-3"AC on >8"Base
(OR Pavements)

Figure 4-2b OR PCI vs AGE For 2 Runways



2-3"AC on >8" Base
All Pavements

Figure 4-2c Combined PCI vs AGE

TABLE 4-1c Regression equations for flexible pavement structural sections consisting of greater than 3 inches AC on any base/subbase.

(1)

(With HIP's)

WASHINGTON
$PCI = 99.8 - 0.31(AGE)^{1.5}$
t-ratio = 7.65
R-sq = 92.1%
SEE = 3.05
N = 7

OREGON
$92.7 - 0.05(AGE)$
t-ratio = 0.26
R-sq = 2.1%
SEE = 5.88
N = 5

COMBINED
$PCI = 89.9 - 0.31(AGE)$
t-ratio = 1.10
R-sq = 11.9%
SEE = 8.92
N = 11

CRICKET GRAPH RESULTS
See Polynomial Fit Fig 4-3a of WA
For Equation R-sq = 92.3%

---

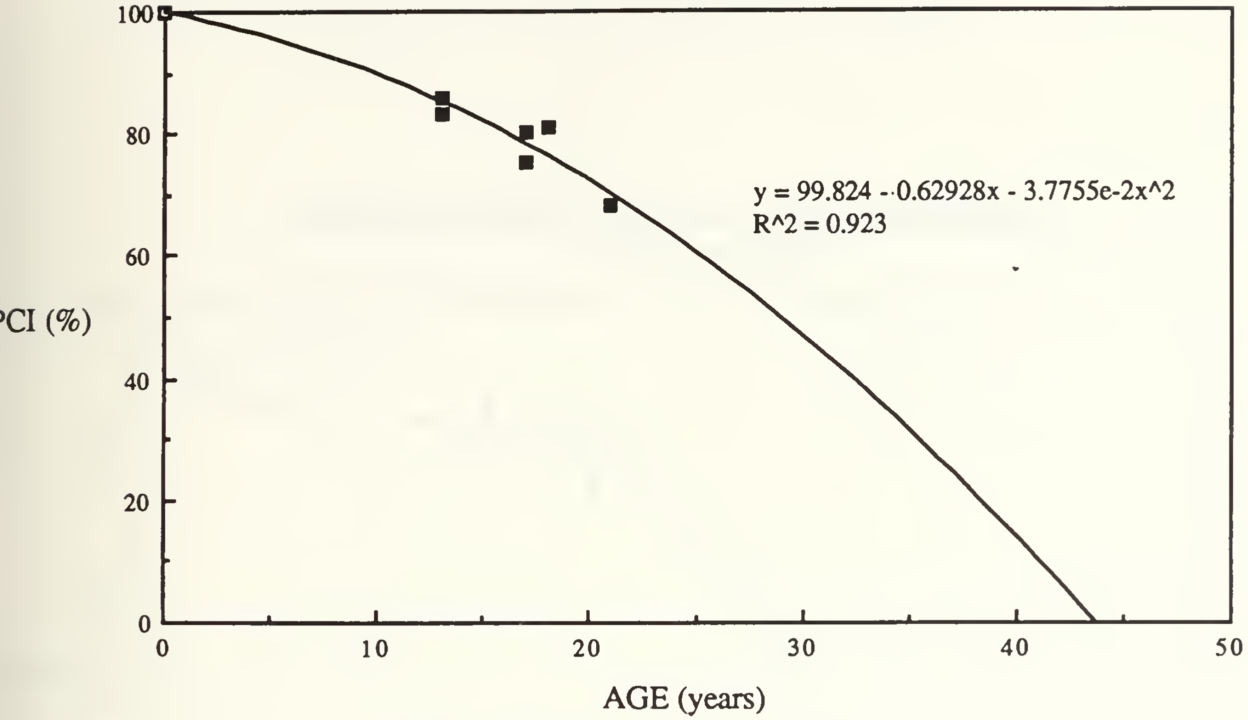
(2)

(Without HIP's)

COMBINED
$PCI = 94.0 - .054(AGE)^2$
t-ratio = 6.39
R-sq = 85.4%
SEE = 3.813
N = 9

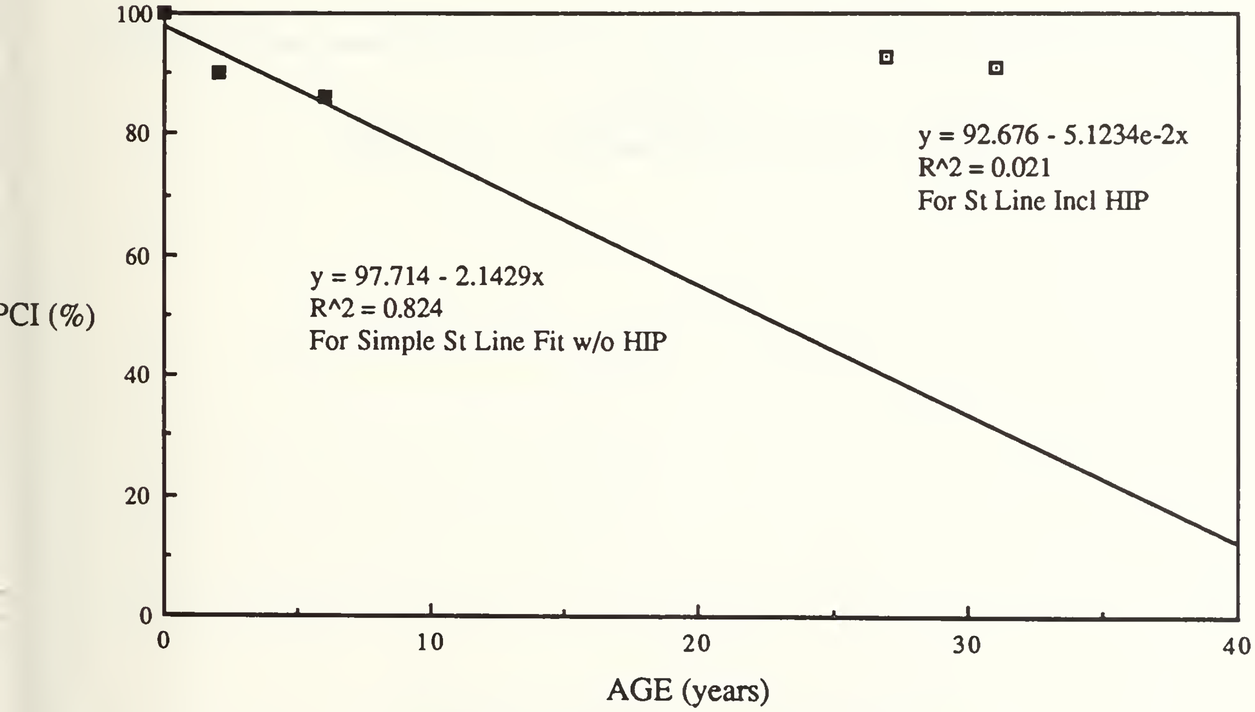
OREGON
$PCI = 97.7 - 2.14(AGE)$
t-ratio = 2.17
R-sq = 82.4%
SEE = 4.276
N = 3

CRICKET GRAPH RESULTS
$PCI = 98.8 - 4.2(AGE) + 0.4(AGE)^2 - 1.3e^{-2}(AGE)^3$
R-sq = 93.1%
N = 9



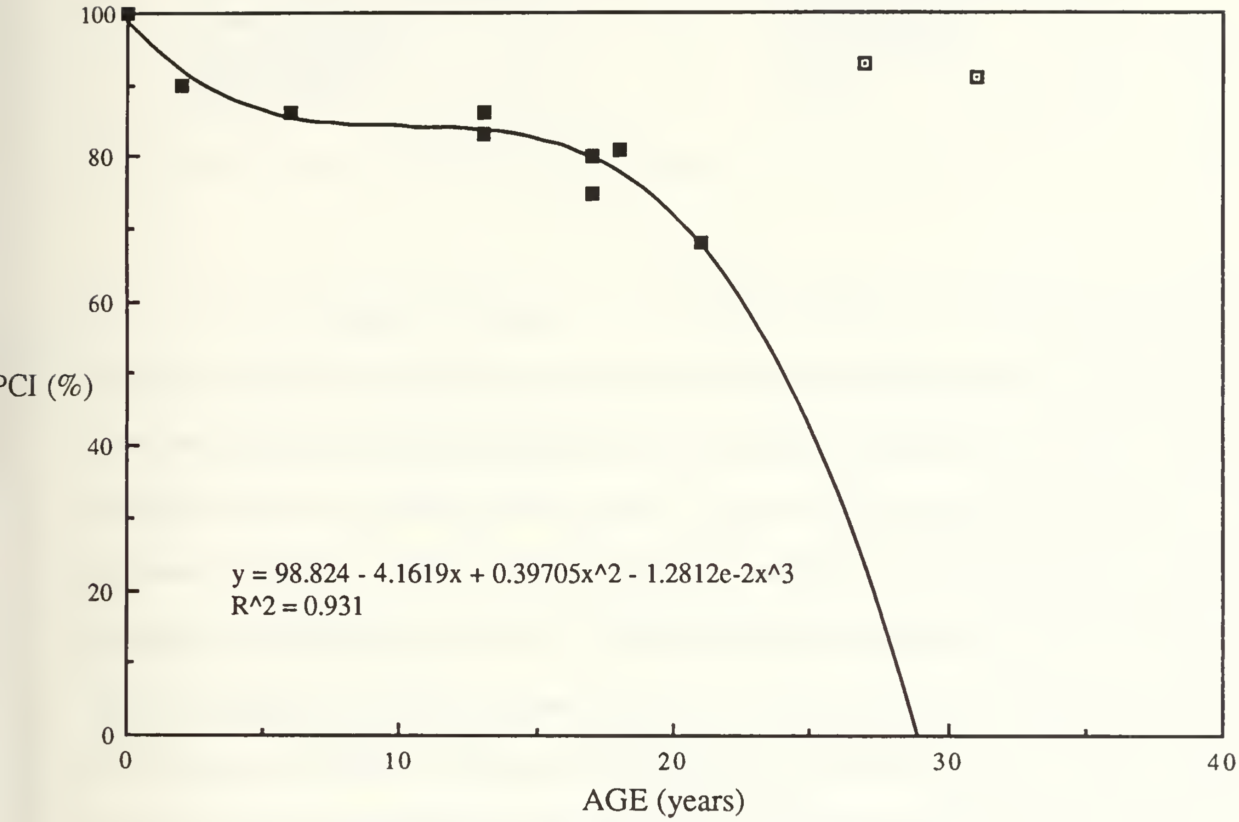
Greater Than 3"AC On Any Base/Subbase (WA Pavements)

Figure 4-3a WA PCI vs AGE For 3 Runways



Greater Than 3"AC On Any Base/Subbase (OR Pavements)

Figure 4-3b OR PCI vs AGE For 2 Runways



Greater Than 3"AC On Any Base/Subbase
All Pavements

Figure 4-3c Combined PCI vs AGE w/o HIP

TABLE 4-1d Regression equations for flexible pavements less than 3 inches AC on 6 - 8 inches of base/subbase built during World War Two

WASHINGTON	**CRICKET GRAPH RESULTS**
$PCI = 100 - 0.0234(AGE)^2$	See Polynomial Fit Fig 4-4
t-ratio = 4.82	For Equation
R-sq = 72.1%	R-sq = 72.1%
SEE = 9.875	N = 11
N = 11	

4.3.1.2 Survival Statistics - Pavement LIFE was estimated by taking the difference between the pavement's original construction date and the date the pavement received the first maintenance application. This assumes the pavement received a surface application due to necessity and not due to other non-structural requirements. The estimated reduction in PCI, rate per year loss, was based on assuming that resurfacing occurred at approximately 55% PCI. The loss is therefore considered to 45% PCI divided by the average LIFE of the pavement section. This assumption also indicates that PCI at construction was 100%. The runway information was divided into the two AC thickness categories shown as compared to three categories previously studied under the first PCI analysis report.

Table 4-1e shows the characteristics for pavement LIFE for those runways constructed after WWII. Refer to Table 3-1e for the individual pavement information and the corresponding corrective measure applied. Table 4-1g depicts those pavements constructed during WWII and the related findings. Refer to Table 3-1f for corresponding individual runway information.

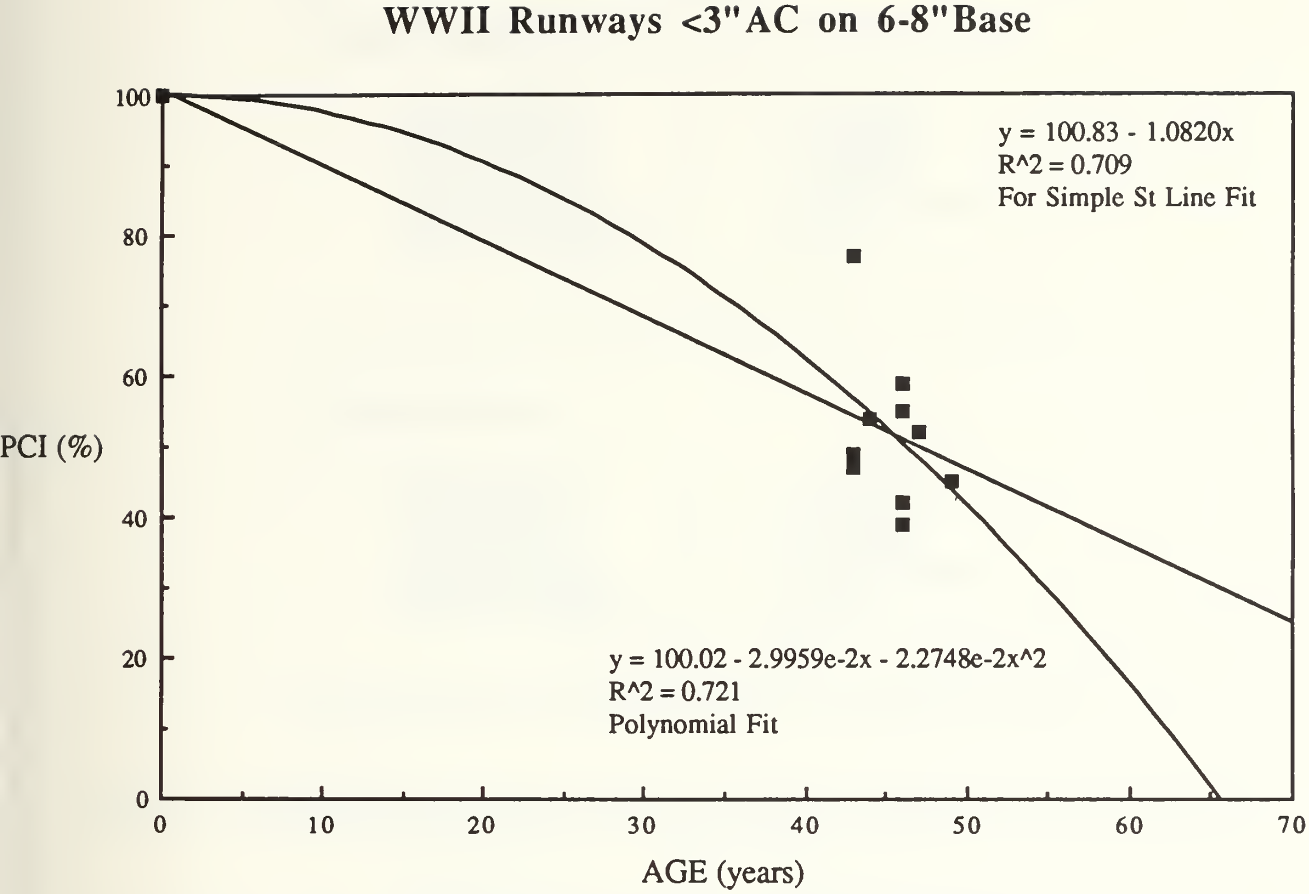


Figure 4-4 WA PCI vs AGE For 5 Runways

TABLE 4-1e Pavement LIFE characteristics for AC pavements constructed after WWII with categories for greater than and less than 3 inches AC.

****

Less than 3 inches

Average LIFE = 14.3 years
Shortest LIFE = 4.0 years
Longest LIFE = 37 years
Avg. PCI LOSS = 3.0% per year
Standard Deviation = 9.5
N = 23

---

3 inches or greater

Average LIFE = 14.9 years
Shortest LIFE = 3.0 years
Longest LIFE = 37.0 years
Avg PCI LOSS = 3.0% per year
Standard Deviation = 10.5
N = 8

****

Note: "N" represents the number of runway pavements in Tables 4-1e, 4-1f, and 4-1g.

TABLE 4-1f Pavement LIFE characteristics for AC pavements constructed after WWII with varying AC thicknesses. Weisenberger [1] results of 1988

****

1/2 inch to 1 1/2 inches

Average LIFE = 11.7 years
Shortest LIFE = 3.0 years
Longest LIFE = 19 years
Avg. PCI LOSS = 3.8% per year
Standard Deviation = 6.24
N = 7

2 inches to 2 1/2 inches

Average LIFE = 13.0 years
Shortest LIFE = 4.0 years
Longest LIFE = 35.0 years
Avg PCI LOSS = 3.5% per year
Standard Deviation = 8.88
N = 13

3 inches or more

Average LIFE = 14.0 years
Shortest LIFE = 10.0 years
Longest LIFE = 18.0 years
Avg PCI LOSS = 3.2% per year
Standard Deviation = 3.78
N = 5

****

TABLE 4-1g Pavement LIFE characteristics for AC pavements constructed during WWII with categories for greater than and less than 3 inches AC. (Washington and Oregon only)

****

Less than 3 inches

Average LIFE = 35.0 years
Shortest LIFE = 21.0 years
Longest LIFE = 43.0 years
Avg PCI LOSS = 1.28% per year
Standard Deviation = 5.5
N = 33

---

3 inches or greater

Average LIFE = 30.2 years
Shortest LIFE = 9.0 years
Longest LIFE = 41.0 years
Avg PCI LOSS = 1.5% per year
Standard Deviation = 8.7
N = 9

****

Weisenberger [1] results of 1988 for WA, OR, and ID.

****

Average LIFE = 27.4 years
Shortest LIFE = 9.0 years
Longest LIFE = 43.0 years
Avg PCI LOSS = 1.6% per year
Standard Deviation = 11.2
N = 42

****

4.3.2 AC Overlays - This category of pavements was evaluated as one group instead of dividing the group in different sections. The primary reason for this choice is that most of the overlay sections consisted of 2-inch surface courses. The FAA AC 150/5380-6 [4] also indicates that varying AC pavement thicknesses, unless significant, do not normally have a sizable impact on PCI ratings if the overlay is not a thin layer.

4.3.2.1 Regression Models - It was not readily apparent from the models listed and depicted on the following pages how well these findings compared to the first PCI analysis report completed by Weisenberger [1], as the latter evaluated results using straight line plots only. The straight line plots for Washington and Oregon in this analysis did not compare favorably with those of the first report. There are significant differences in R-squared and SEE values, (confidence and estimate error values, respectively) with the findings of this report being less favorable, i.e. lower values computed than previously. The exponential and polynomial applications to the data, without high influence points, produced better results in terms of expected theoretical representations.

4.3.2.2 Survival Statistics - LIFE computations were the same as those found in Weisenberger's [1] study as none of the pavements have received treatment since then.

TABLE 4-2a Pavement LIFE characteristics for AC overlays with 2 to 4 inches AC - Weisenberger [1].

****

Average LIFE = 11.6 years
Shortest LIFE = 8.0 years
Longest LIFE = 16.0 years
Avg PCI LOSS = 3.9% per year
Standard Deviation = 2.63
N = 7

****

TABLE 4-2b Regression equations for flexible pavement structural sections consisting of AC overlays ranging from 3/4 to 3 inches on any base/subbase.

(1)

(With HIP's)

WASHINGTON

PCI = 93.2 - 1.23(AGE)
t-ratio = 3.1
R-sq = 29.5%
SEE = 10.01
N = 25

OREGON

PCI = 92.4 - 1.17(AGE)
t-ratio = 2.44
R-sq = 35.1%
SEE = 6.99
N = 13

COMBINED

PCI = 90.8 - 1.03(AGE)
t-ratio = 3.17
R-sq = 23.3%
SEE = 9.32
N = 37

CRICKET GRAPH RESULTS

PCI = 93.25 - 1.23(AGE) WA
R-sq = 29.5% N = 25

PCI - 92.4 - 1.17(AGE) OR
R-sq = 35.1% N = 13

---

(2)

(Without HIP's)

WASHINGTON

PCI = 92.2 - 0.453$(AGE)^{1.5}$
t-ratio = 5.79
R-sq = 66.4%
SEE = 7.3
N = 19

OREGON

PCI = 92.5 - 0.5$(AGE)^{1.5}$
t-ratio = 3.08
R-sq = 51.3%
SEE = 6.65
N = 11

COMBINED

PCI = 91.3 - 0.44$(AGE)^{1.5}$
T-ratio = 6.84
R-sq = 63.4%
SEE = 6.78
N= 31

CRICKET GRAPH RESULTS

PCI = 91.75 - 1.11(AGE)

See Fig 4-5c For Polynomial Fit
R-sq = 48.3% (3 HIP's omitted)
N = 34

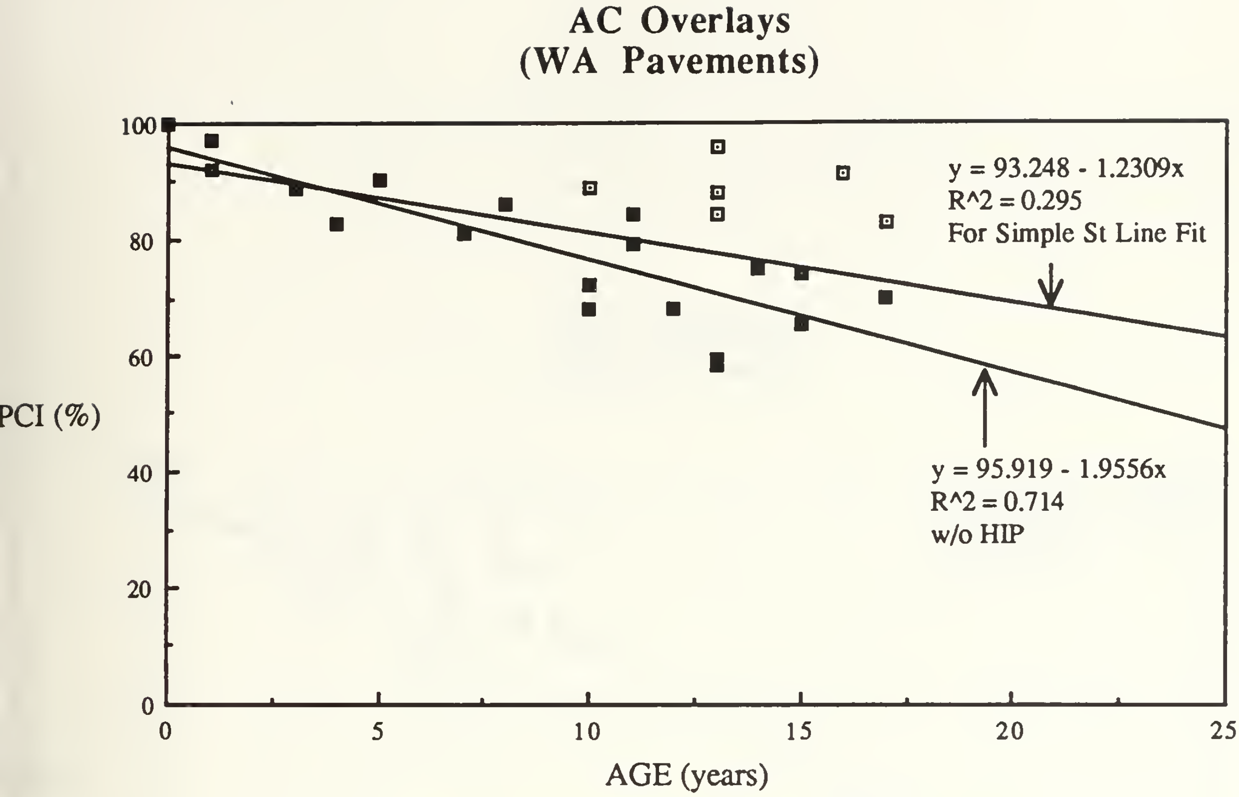


Figure 4-5a WA PCI vs AGE For 12 Runways

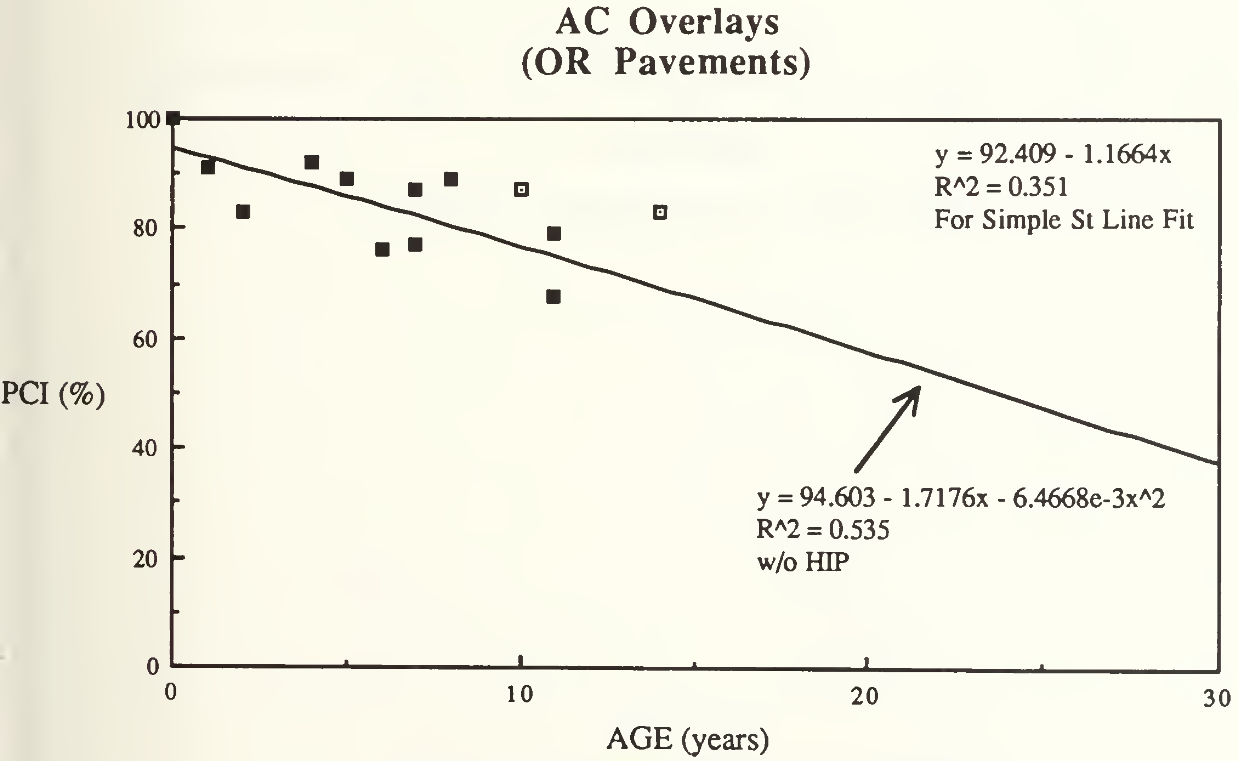


Figure 4-5b OR PCI vs AGE For 6 Runways

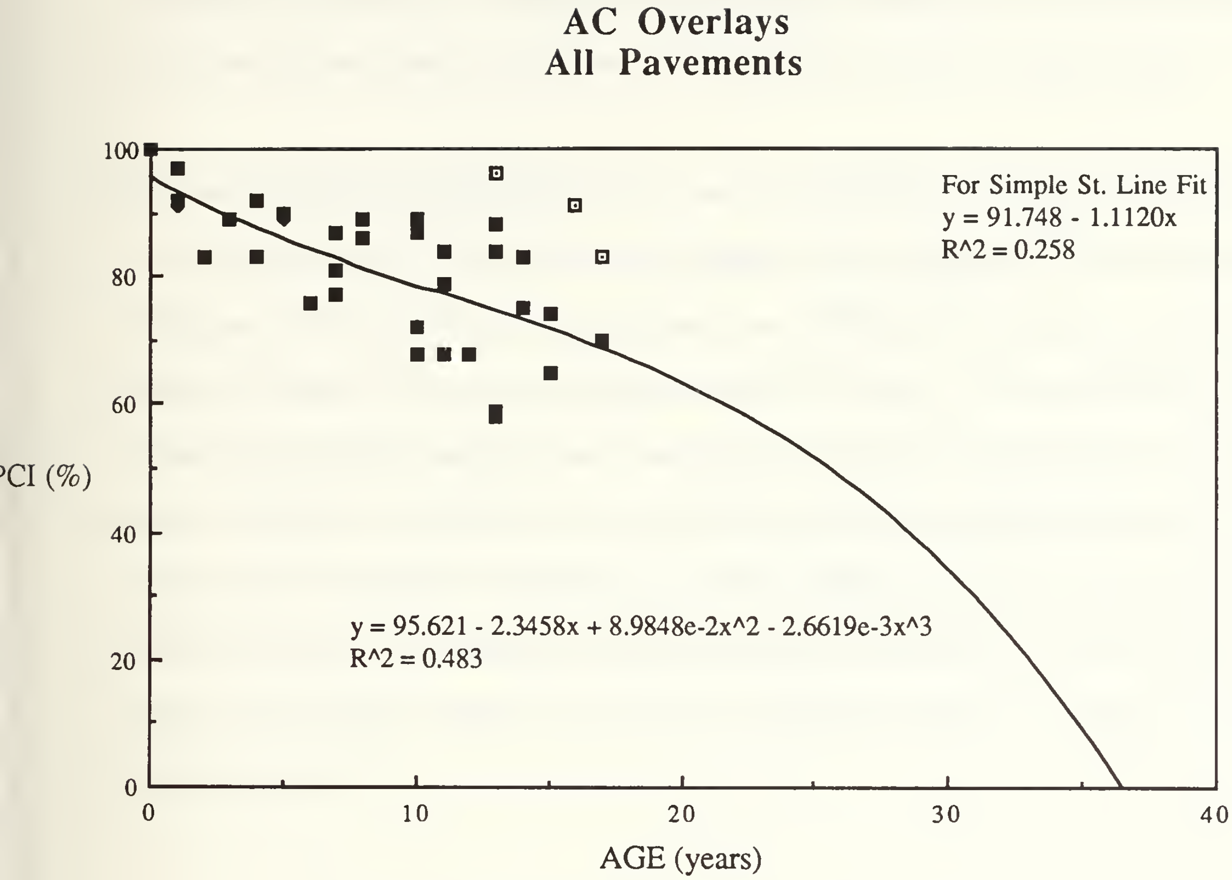


Figure 4-5c Combined PCI vs AGE w/o HIP

4.3.3 Bituminous Surface Treatments - The data compiled for bituminous pavements provided what was interpreted as two possible trends of pavement performance. As a result of this observation, it was decided to examine the two separate trend categories and compare the findings. As stated in Chapter Three, an attempt was not made to evaluate BST's based on the number of treatments or the make-up of the BST surface course.

The results listed and depicted could not be compared with the first PCI analysis report as the models/equations developed in this category were accomplished with non-linear applications. The separation into upper and lower divisions of data provided excellent results particularly in the case of the upper division data points. The lower points points yielded less favorable results, but were not totally unacceptable. Segregation of the data points would pose a problem from an individual runway standpoint however, as a determination would have to be made as to which of the two models would apply to the individual situation. The combined model provides low confidence results, therefore it would seem prudent to select one of the two "partition" models to compare with the individual pavement.

TABLE 4-3a Regression equations for flexible pavement structural sections consisting of bituminous surface treatments on any base/subbase. Data is categorized in "upper" and "lower" portions based on interpreted trends in the data with respect to various runways.

(1)

WASHINGTON(upper)

$PCI = 97.0 - .07(AGE)^{2.5}$
t-ratio = 22.87
R-sq = 99.1%
SEE = 2.61
N = 7

WASHINGTON(lower)

$PCI = 86.2 - 6.91(AGE)$

R-sq = 71.8%

N = 11

OREGON

$PCI = 99.0 - 2.0(AGE)$
t-ratio = 4.62
R-sq = 95.5%
SEE = 3.74
N = 3

COMBINED

$PCI = 78.8 - 0.49(AGE)^{1.5}$
t-ratio = 1.93
R-sq = 18.0%
SEE = 18.59
N = 19

---

(2)

COMBINED(upper)

$PCI = 95.5 - 0.175(AGE)^{3}$
T-ratio = 9.71
R-sq = 93.1%
SEE = 5.97
N= 9

COMBINED(lower)
Same as "Washington (lower)"

CRICKET GRAPH RESULTS

See Fig 4-6a For Polynomial Fit WA
R-sq = 98.8%

See Fig 4-6b for St. Line Fit For OR
R-sq = 95.5%

Same as "Washington (lower)"
See Fig 4-6c For Combined Plots

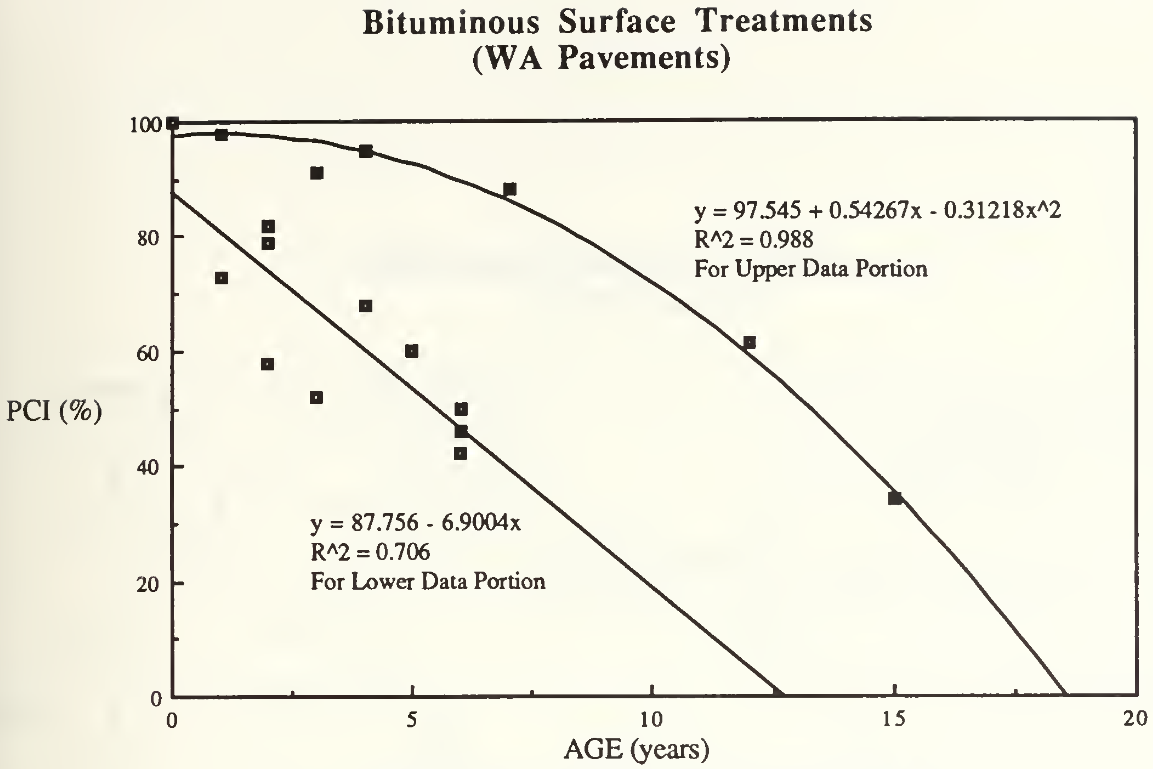


Figure 4-6a WA PCI vs AGE For 8 Runways
Data is "Partitioned" in Two Categories

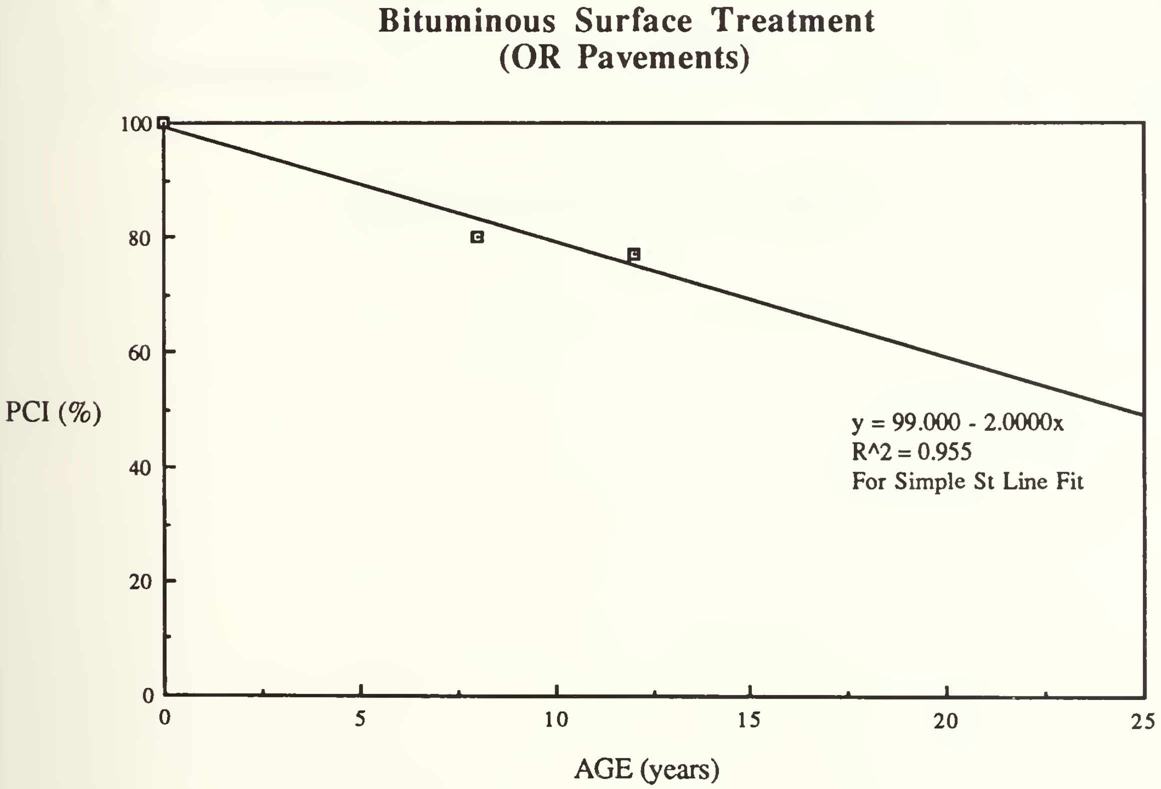


Figure 4-6b OR PCI vs AGE For 1 Runway

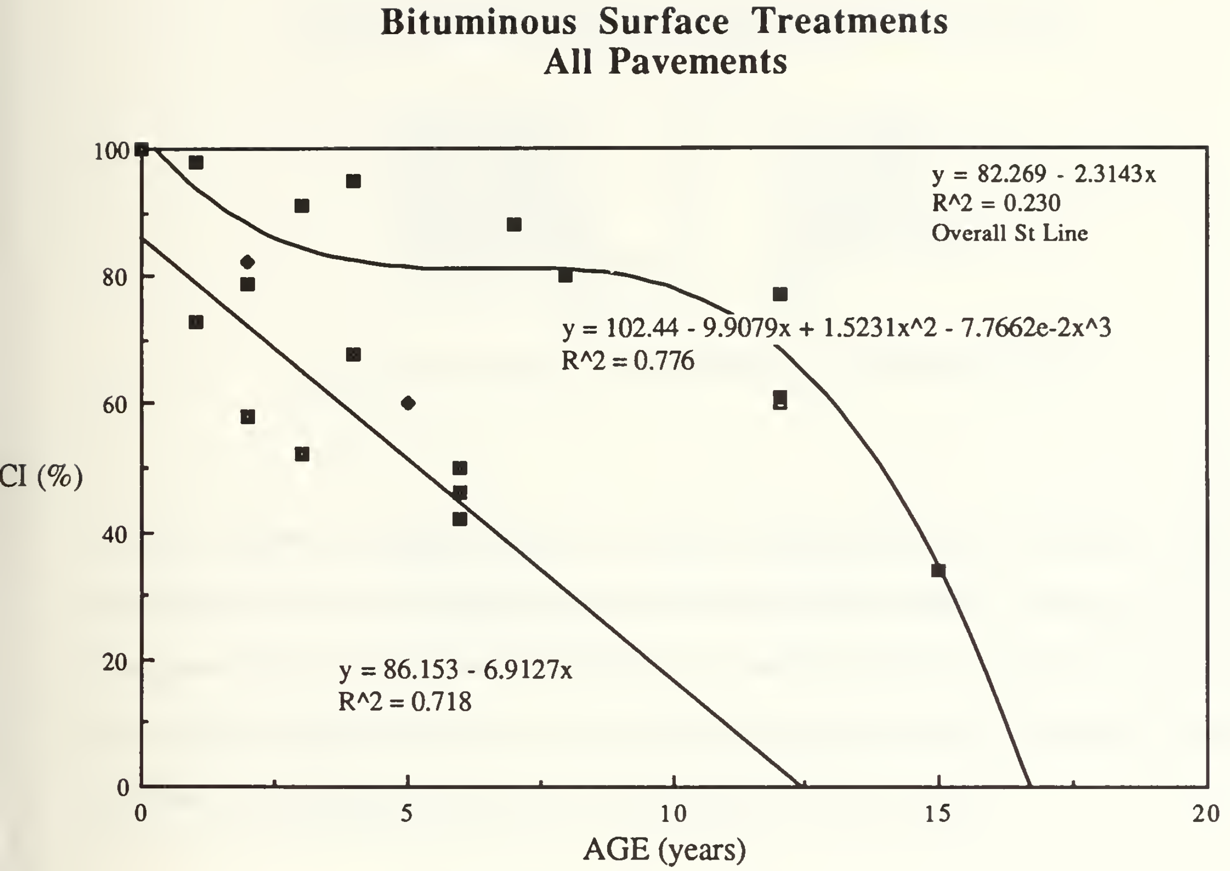


Figure 4-6c Combined PCI vs AGE With Data "Partitioned" in Two Categories

TABLE 4-3b Pavement LIFE characteristics for pavements with bituminous surface treatments.

****

Average LIFE = 14.4 years ←
Shortest LIFE = 11.0 years
Longest LIFE = 17.0 years
Avg PCI LOSS = 3.125% per year
Standard Deviation = 2.19
N = 5

****

The few number of runways used for the LIFE investigation portion of bituminous surface treatments may lessen the applicability of the findings shown above, however the findings are presented for reference and future analysis. The five runways evaluated were the only ones in this study of runways with two sets of PCI surveys where a subsequent surface treatment had been applied to the previous bituminous surface course.

TABLE 4-3c Pavement LIFE characteristics for pavements with bituminous surface treatments with BST and DBST categories - Weisenberger [1].

****

All data points

Average LIFE = 9.2 years
Shortest LIFE = 1.0 year
Longest LIFE = 29.0 years
Avg PCI LOSS = 4.9% per year
Standard Deviation = 6.4
N = 22

BST applications

Average LIFE = 8.8 years
Shortest LIFE = 6.0 years
Longest LIFE = 18.0 years
Avg PCI LOSS = 5.1% per year
Standard Deviation = 5.17
N = 5

DBST applications

Average LIFE = 5.6 years
Shortest LIFE = 2.0 years
Longest LIFE = 13.0 years
Avg PCI LOSS = 8.0% per year
Standard Deviation = 3.4
N = 9

****

4.3.4 Surface Maintenance Applications and Techniques - Chapter Three indicated the evaluation of only slurry seals in this report since this technique was the only one common to runways with two sets of PCI surveys. As in the case of BST's, two categories were observed in Washington pavements. The two were evaluated and are presented in Table 4-4b and Figures 4-7a through 4-7c. The graphic plot in Figure 4-7c of the combined data points is a polynomial equation but as evidenced by the plot of the equation, the curve shows a slight upward trend between approximately five and twelve years. This portion of the curve is therefore not a good depiction of real life pavement performance especially in the case of slurry seals. The combined regression models, with and without high influence points, do not provide reliable models for application to individual pavements. These findings are attributable to data that one would normally expect to gather on slurry seal surfaces. Construction methods and materials are critical to the finished product. In addition, the assumption of using PCI = 100% at AGE = 0 is probably not a good one, as slurry seal surface treatments apparently do not result in a PCI rating of 100% at AGE = 0. Pavement LIFE results from the Weisenberger [1] report are listed below.

TABLE 4-4a Pavement LIFE characteristics for slurry seal pavements.
Weisenberger [1]

****

Average LIFE = 5.6 years
Shortest LIFE = 3.0 years
Longest LIFE = 10.0 years
Avg PCI LOSS = 8.0% per year
Standard Deviation = 2.99
N = 6

****

TABLE 4-4b Regression equations for flexible pavement structural sections with slurry seal surface maintenance applications. Washington pavements were again segregated into two sections, with the upper portion addressed in this table.

WASHINGTON*

$PCI = 87.3 - 0.42(AGE)^{1.5}$
t-ratio = 7.3
R-sq = 85.5%
SEE = 6.35
N = 11(upper)

COMBINED(w/HIP)

$PCI = 72.6 - 0.2(AGE)^{1.5}$
t-ratio = 2.15
R-sq = 18%
SEE = 13.11
N = 23

COMBINED(w/o HIP)

$PCI = 71.9 - 0.23(AGE)^{1.5}$
t-ratio = 2.59
R-sq = 26.1%
SEE = 12.33
N = 20

OREGON

$PCI = 79.9 - 1.37(AGE)^{1.5}$
t-ratio = 1.69
R-sq = 36.4%
SEE = 12.17
N = 7

CRICKET GRAPH RESULTS

See Fig 4-7a For Curve Fits WA
R-sq = 87% For Polynomial Fit

See Fig 4-7b For St. Line Fit OR
R-sq = 46.5%

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* Note: The analysis did not include PCI = 100 at AGE = 0. See Appendix D for MINITAB printouts of both cases.

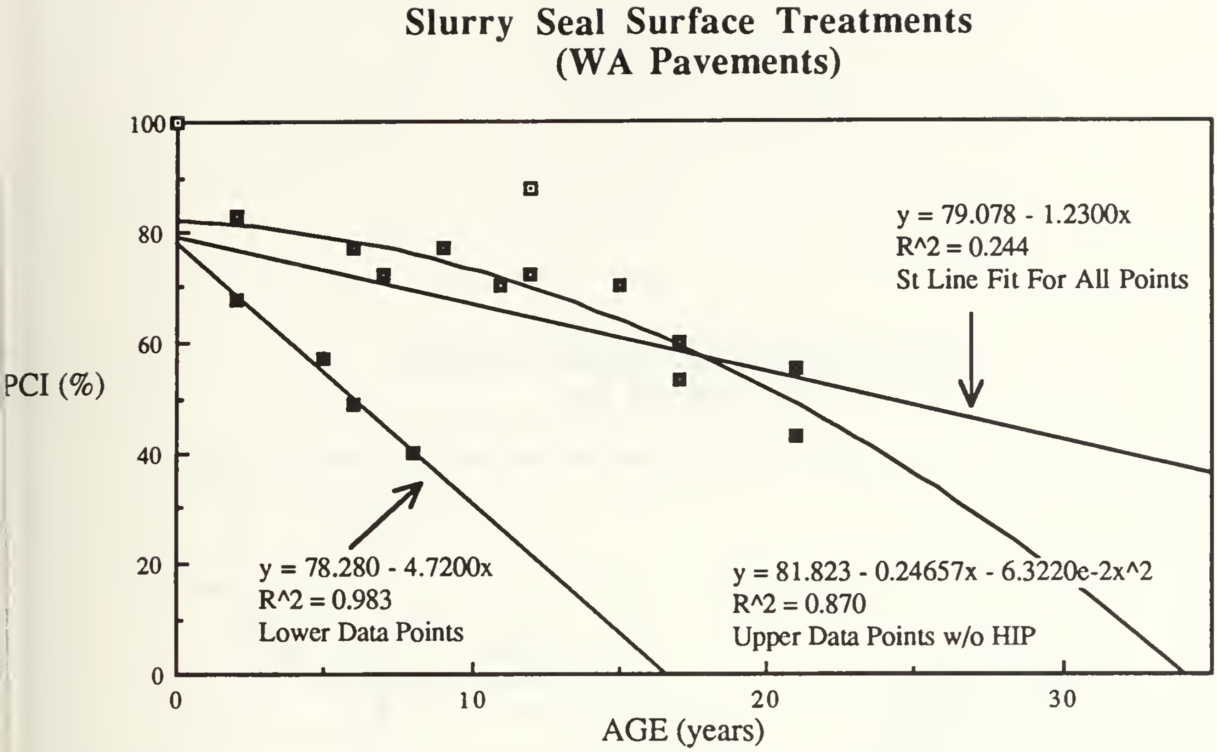

Slurry Seal Surface Treatments (WA Pavements)

Figure 4-7a WA PCI vs AGE For 8 Runways w/Data "Partitioned" in Two Categories

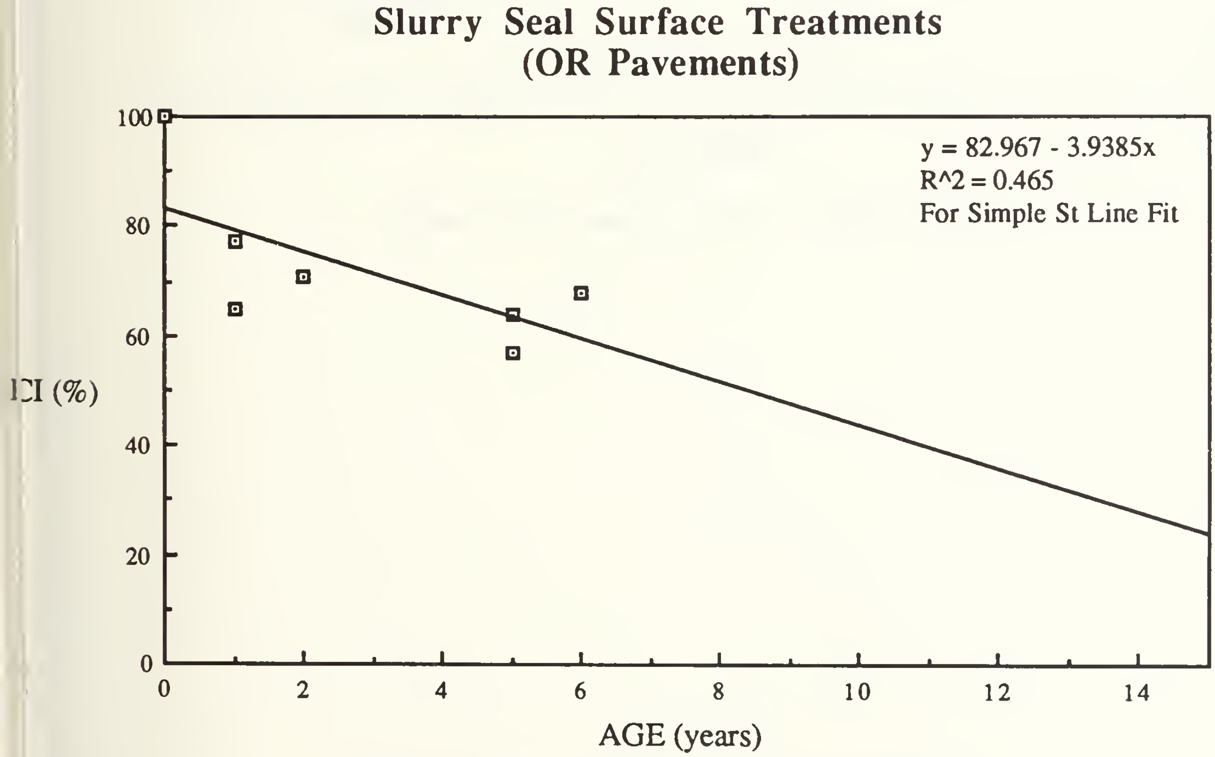

Slurry Seal Surface Treatments (OR Pavements)

Figure 4-7b OR PCI vs AGE For 3 Runways

Slurry Seal Surface Treatments
All Pavements

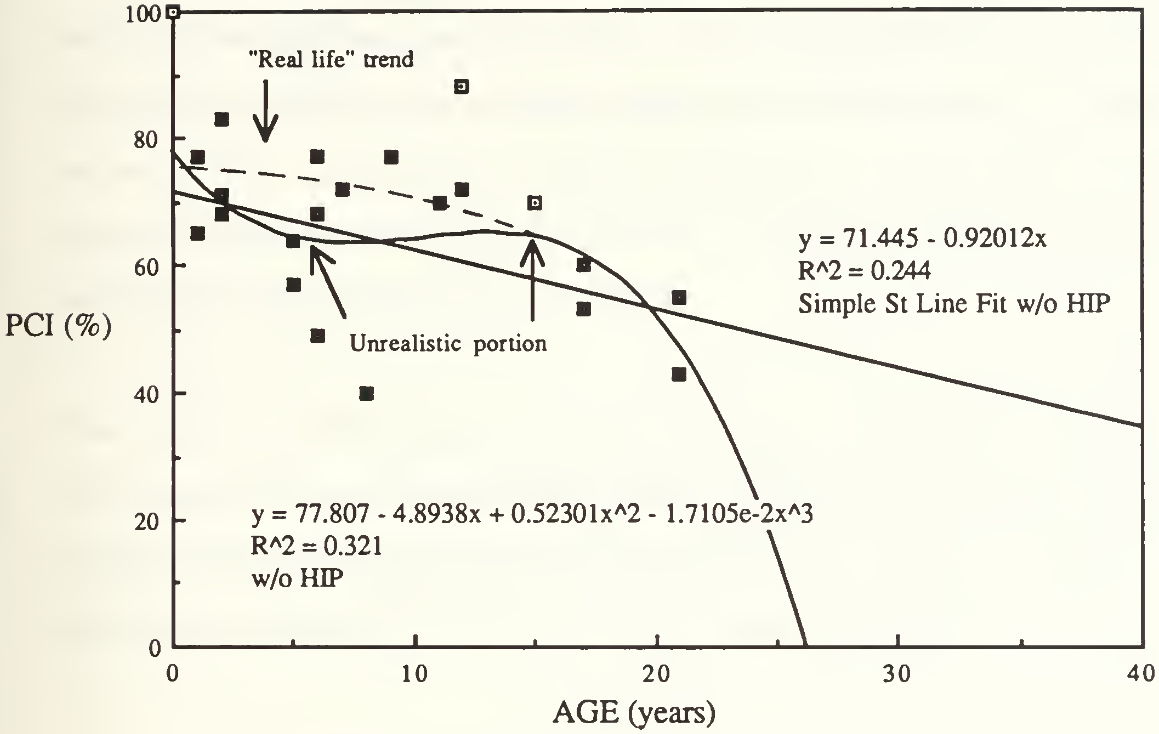


Figure 4-7c Combined PCI vs AGE w/o HIP

4.3.5 Portland Cement Concrete (PCC) Pavements - Eight rigid PCC pavements with sixteen data points as individually listed in section 3.5.5 were analyzed. The lone pavement that was not constructed during WWII is Condon State airport in Oregon. This runway is apparently deteriorating at an overall rapid rate of 4.5% PCI per year, more than four times that of the Washington pavements, as evidenced by the slope of the straight lines. The small R-squared and high SEE values for the Washington and Combined categories preclude these models from being used in a reliable fashion. In the first PCI analysis report, virtually the same model equation was obtained, however, the model did not include PCI = 100 at AGE = 0. When this point was included, the model yielded a second equation with an R-squared (adj) value of 71.3% and a SEE value of 12.97, compared to the values listed in Table 4-6 below.

There were two significant groups of runway PCI results for Washington, with four of the seven runways in one group and three in another. No reasonable explanation for the two groupings could be determined from individual files on the respective pavements. All upper points were above PCI = 67%, and all lower points were below PCI = 47%.

TABLE 4-5 Regression equations for portland cement concrete pavements.

WASHINGTON

PCI = 99.5 - 0.88(AGE)
t-ratio = 1.69
R-sq = 18.0%
SEE = 23.51
N = 15

OREGON

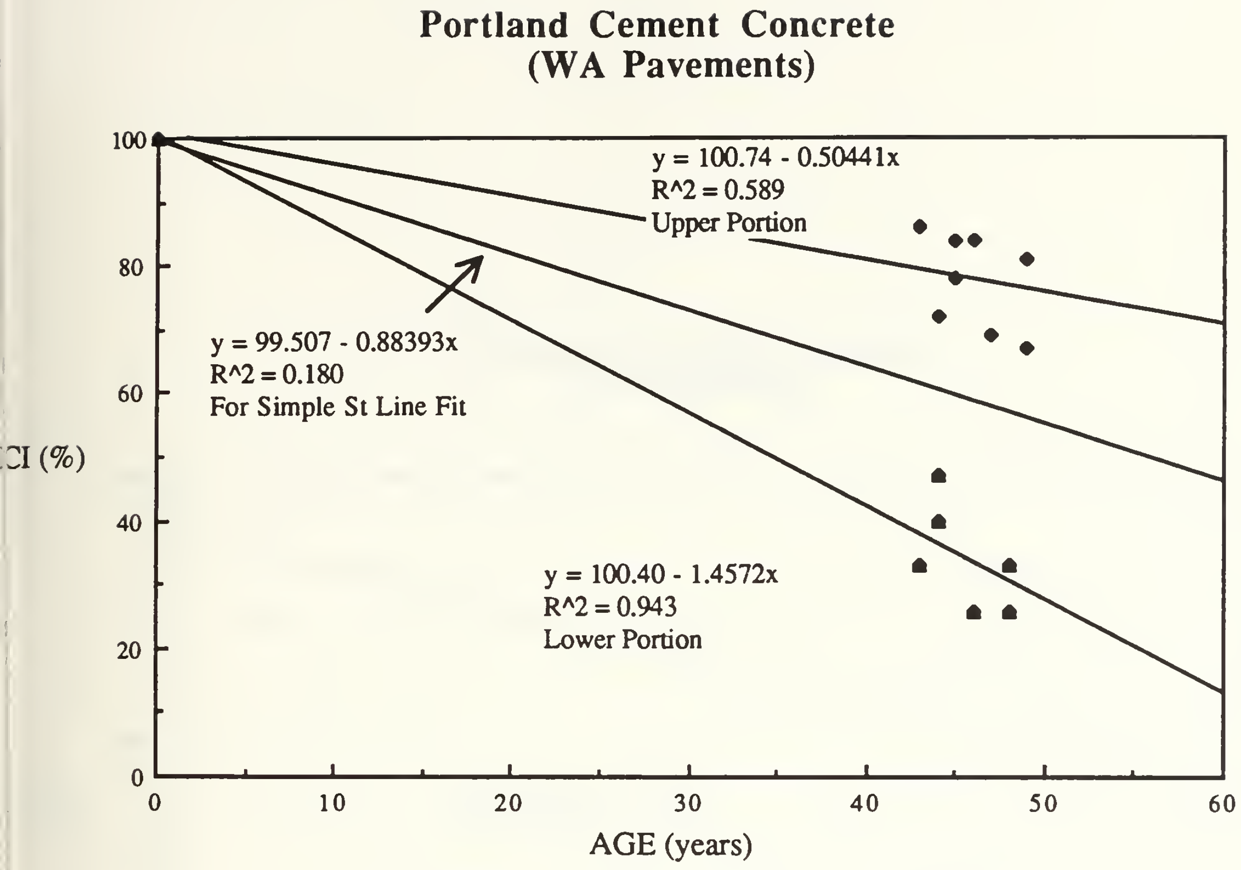
PCI = 99.2 - 4.29(AGE)
t-ratio = 12.99
R-sq = 99.4%
SEE = 1.234
N = 3

COMBINED

PCI = 92.4 - 0.73(AGE)
t-ratio = 2.29
R-sq = 25.9%
SEE = 22.15
N = 17

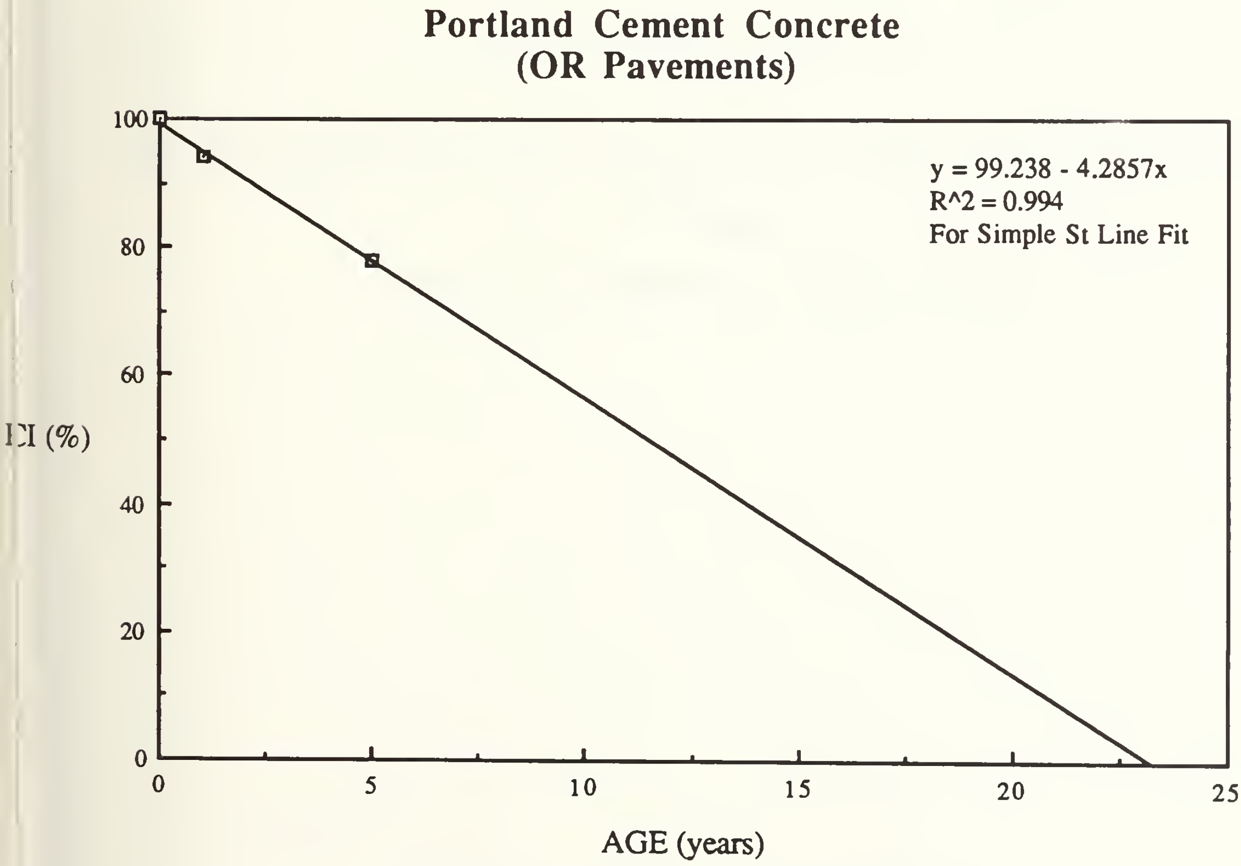
CRICKET GRAPH RESULTS

See Fig 4-8a through 4-8c For Plots
All St. Line Plots Same as MINITAB



Portland Cement Concrete (WA Pavements)

Figure 4-8a WA PCI vs AGE For 7 Runways



Portland Cement Concrete (OR Pavements)

Figure 4-8b OR PCI vs AGE For 1 Runway

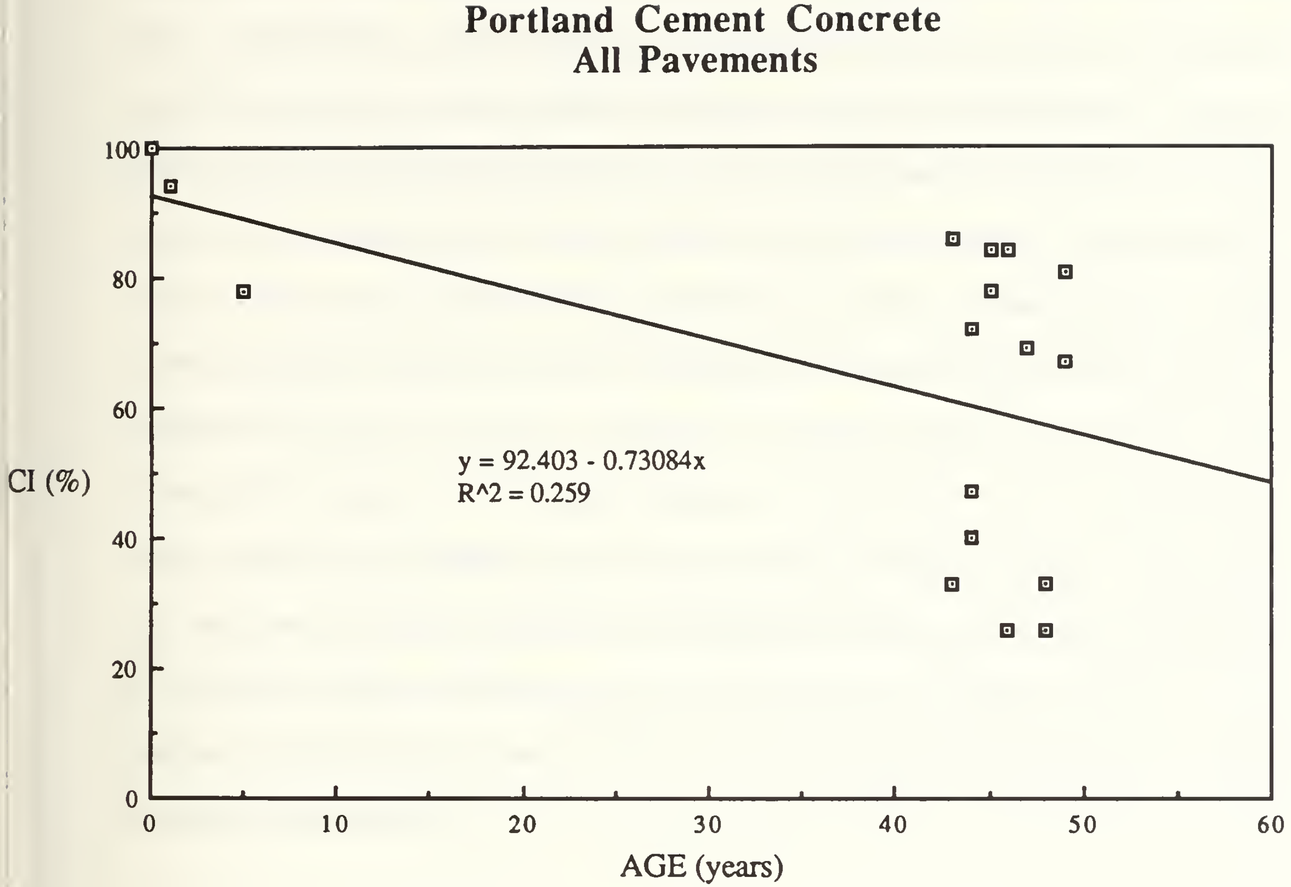


Figure 4-8c Combined PCI vs AGE All Points

4.4 DISCUSSION

4.4.1 Deterioration Rate Comparisons - No distinct trend of better performance was observed throughout the analysis with the exception of PCC pavements in section 4.3.5. The inclusion or exclusion of high influence points made a significant difference in several cases in terms of the model fit of the data. The lack, or inconsistency, of data is a possible reason, but there could also be no one factor attributable to a trend or lack thereof. In some cases Washington pavements performed better than Oregon's, and in other cases worse. The amount of data heavily favored the evaluation of Washington pavements, however this fact works both in favor and against when attempting to assess trends. As mentioned previously, factors to consider in evaluating disparity in the data include construction method and materials, however, other factors to be considered are: environment, aircraft loading, survey inspector, and survey consistency. Deterioration rates were more noticeable between surface applications with the most significant decreases in bituminous surface treatments and slurry seals. In addition, pavement LIFE comparisons for flexible pavements did not reveal any significant differences with respect to surface course thickness.

4.4.2 Surface Maintenance Techniques - A survey of the PCI and AGE data of surface maintenance applications reveals that these applications are being primarily used to extend the individual pavement life. The PCI surveys conducted after maintenance treatment of the surface courses reveal only slight increases in pavement ratings. The corrective measures are not sufficient to overcome whatever deficiencies are present in the underlying pavement or restore the respective pavements to near original condition. In addition, the LIFE calculations determined by Weisenberger [1] for AC overlays, BST's, and slurry seals indicate shorter average life spans than those obtained from the analysis conducted in this report.

4.4.3 Exponential vs Poynomial Modeling - This comparison was addressed to some extent earlier in this chapter. The polynomial models developed for several of the categories would seem to encourage the use of exponential models due to the lesser complexity. Several "reliable" models, based on the available data, were developed using the exponential approach of MINITAB, while for the most part polynomial fits were used in the case of graphic depictions. The data also "suggests" that straight line fits were adequate in certain cases. In all cases, however, the R-squared element for polynomials was near or the same value as that developed for the exponential. The exponential method, $PCI = B_0 + B_1(AGE)^n$, is the preferred method for simplicity and usage by pavement managers.

4.4.4 PCI Acceptable Limits - The use of 55% PCI as the minimum acceptable PCI rating for pavement repair or rehabilitation is questionable due to the possible implications on survivability of individual pavements. The FAA actually recommends the use of 70% for considering a pavement unusable and in need of maintenance. If this figure is used, the LIFE of many pavements can be reduced by as much as a half, which would seem to be more realistic.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, & RECOMMENDATIONS

5.1 SUMMARY

The intent of this paper was to develop models or equations that would be useful to an airport manager or planner in the application of their respective pavement management systems. The regression equations and graphic depictions were developed using select data. The applicability of this data and the corresponding models to a vast number of airfield pavements is obviously restrictive due to the number of data points available. This report, however, is another step towards better models developed from more data, which will be obtained from more PCI surveys. The models included in this report can be used as a guideline for interpreting individual pavements or as a comparison tool if the trend of an individual pavement does not "match" the performance of that particular pavement. In essence, as the database increases due to reports such as this so will the available models that will become available to planners and managers. These models will in turn assist airport professionals in maintenance and budget planning.

As more information is gathered the need for even more to strengthen the results obtained, and conclusions drawn, is evident. Comparisons, where possible, between this report and the first PCI analysis indicate that the models yielded some of the same results. However, due to this report's emphasis on curvilinear representations of a pavement's performance, full comparisons of results could not be adequately accomplished. The representation of a pavement's performance as a straight line is not an overall correct depiction. Individual

portions of a performance curve may be shown as straight lines, but the full performance plot needs to be shown as a curve. This therefore further amplifies the need for additional information to reinforce the exponential and polynomial models presented in this report.

The FAA continues to conduct PCI surveys but the process is slow due to the number of general aviation airports in the region, and the time associated with accomplishing each. This report only addressed 202 of the 240 runways discussed in the first analysis, of which over 100 have second sets of PCI surveys. However, only 78 runways showed PCI's lower than previously, indicating maintenance or corrective applications and/or inconsistent surveys. The state of Idaho has yet to commence it's second set of PCI surveys to compare the results obtained from those accomplished in 1986

5.2 CONCLUSIONS

As just stated, the regression models and pavement life results obtained from the data analyzed provide approximate depictions of various pavements' performance. With an understanding of the limitations of the developed models, an individual can use the results of these equations and graphs as a tool to assist in the pavement management arena.

As is normally the case, budgets dictate the route of pavement maintenance and repair. Discussions with some airport managers and WSDOT indicates that the PCI information is a valuable asset to an airport planner, but cost considerations in replacement and corrective action is always the final determinant. This is readily evident from the significant number of runways with PCI ratings in the "poor" to "very poor" range. PCI surveys and their long terms effects on managing for the future of pavements need to be a continued management high priority item.

5.3 RECOMMENDATIONS

The next step in collecting PCI data should be the use of the automated data collection. Although this would be a significant initial investment the cost would be recovered in time due to the reduced time and manpower expended in conducting these surveys. The mobile data collection vehicle which takes photographs of a pavement as it travels over the surface could be used in the tri-state area or perhaps two units could be dedicated to the Northwest Region of the FAA and the units shared throughout the seven states covered. This shared coverage would reduce the overall cost of the vehicles and a general schedule could be developed to ease the collection of PCI data for each state. The saved time in surveys would translate to quicker development of models which in turn would be available in a shorter time frame to the airport managers.

The PCI scale requires a more rigid definition especially at the level of acceptability rating. A pavement rated as "fair", PCI = 40 -> 55%, does not give the impression of urgency with respect to pavement upgrade or replacement, and as such may not be given the needed attention from a management or planning standpoint. If the same pavement were deemed unacceptable, then it is anticipated that more pressure would be applied to effect an upgrade of the pavement.

The development of consistent terminology in reports from the surveys is another significant hurdle which needs to be remedied to ease the interpretation of future surveys. Finally, the completeness of individual surveys needs to be improved upon with priority given to the reasons for maintenance or corrective actions.

PCI surveys are critical to an effective pavement management system, whether at a major metropolitan airport or a general aviation airport. It is essential that surveys continue to be conducted and monitored to better plan the pavements of the future and maintain the ones in operation today. Furthermore, it is important for the models developed to be used to whatever extent possible and the confidence level increased by supplementing the existing database with more data from follow-on surveys.

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APPENDIX A

WASHINGTON STATE
GENERAL AVIATION
PAVEMENT CONDITION SURVEY DATA

INCLUDING:

1) AIRPORT LOCATION/DESCRIPTION/SECTION DATA
2) PAVEMENT IDENTIFICATION & CHARACTERISTICS
3) AVERAGE PCI VALUES FOR PAVEMENT FEATURES
4) PAVEMENT CONDITION SURVEY DATES
5) AVERAGE PCI LOSS WITH AGE
6) REPAIR AND REHABILITATION INFORMATION
7) OTHELLO MUNICIPAL AIRPORT COMPLETE PCI SURVEY

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APPENDIX LEGEND

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ID	Runway/Feature Identification Number
OCD	Original Construction Date
PCI	Pavement Condition Index
AVG	Average
YR	Year
RRD	Ruway Rehabilitation Date
ORIG	Original
STRUC.	Structural
SEC.	Section
SURVEY	PCI Inceased Value Attributed To Survey Conducted

PCI DATA (WA) W/AVG LOSS

No.	AIRPORT & LOCATION	ID	OCD	PCI AVG & YR	PCI AVG & YR	AVG LOSS/YR
1	ANACORTES AP	R1	1968	96 - 1986	91 - 1989	1.67
		R2	1968	95 - 1986	90 - 1989	1.67
		R3	1968	100 - 1986	92 - 1989	2.67
2	ARLINGTON MUNICIPAL AP	R1	1942	77 - 1986	78 - 1989	SURVEY
		R2	1942	89 - 1986	84 - 1989	2.67
3	AUBURN MUNICIPAL AP	R1	1968	81 - 1987	84 - 1991	OVERLAY
		R2	1983	90 - 1987	87 - 1991	0.75
4	BLAINE MUNICIPAL AP	R1	1972	72 - 1988	N/A	
5	BOWERMAN FIELD, HOQUIAM	R1	1943	77 - 1986	59 - 1989	6
		R2	1943	86 - 1986	84 - 1989	0.67
		R3	1943	33 - 1986	26 - 1989	2.33
6	BOWERS FIELD, ELLENSBURG	R1	1976	67 - 1986	64 - 1989	1
		R1A	1942	46 - 1986	60 - 1989	SLURRY SL
		R2	1942	67 - 1986	INOP	
		R3	1942	57 - 1986	64 - 1989	SURVEY
		R4	1942	54 - 1986	52 - 1989	0.67
7	BREMERTON NATIONAL	R1	1942	86 - 1987	86 - 1991	0
		R2	1942	83 - 1987	75 - 1991	2
		R3	1942	86 - 1987	80 - 1991	1.5
		R4	1942	88 - 1987	83 - 1991	1.25
		R5	1942	82 - 1987	80 - 1991	0.5
8	CASHMERE - DRYDEN AP	R1	1951	72 - 1988	N/A	
9	CHEHALIS - CENTRALIA AP	R1	1942	84 - 1987	81 - 1991	0.75
		R2	1942	78 - 1987	67 - 1991	2.75
10	CLE ELUM MUNICIPAL AP	R1	1987	56 - 1988	N/A	
11	COLVILLE MUNICIPAL AR	R1	1949	33 -1986	62 - 1989	TBST ADDED
12	CONCRETE MUNICIPAL	R1	1974	61 - 1986	34 - 1989	9
13	CONNELL CITY AP	R1	1970	69 - 1987	79 - 1991	AC OVLY
14	CREST AP, KENT	R1	1967	97 - 1987	90 - 1991	1.75
15	DAVENPORT AP	R1	1984	82 - 1986	60 - 1989	7.33
16	DEER PARK AP	R1	1943	45 - 1986	76 - 1989	???
		R2	1976	72 - 1986	74 - 1989	SURVEY
		R3	1943	47 - 1986	39 - 1989	2.67
17	ELMA MUNICIPAL AP	R1	1976	88 - 1988	83 - 1991	1.67
18	EPHRATA MUNICIPAL	R1	1943	89 - 1987	83 - 1991	1.75
		R1A	1943	60 - 1987	55 - 1991	1.25
		R2	1943	53 - 1987	43 - 1991	2.5
		R2A	1943	47 - 1987	26 - 1991	5.25
		R2B	1983	89 - 1987	84 - 1991	1.25
19	EVERGREEN FIELD, VANCOUVER	R1	1967	55 - 1987	51 - 1991	1
		R2	1971	86 - 1987	77 - 1991	2.25
20	FERRY COUNTY (REPUBLIC) AP	R1	1974	65 - 1986	70 - 1991	CHP SL ADDED
21	GRAND COULY DAM AP	R1	1972	86 - 1986	N/A	2"AC OVLY
	(ELECTRIC CITY)	R2	1980	84 - 1986	N/A	SURVEY

PCI DATA (WA) W/AVG LOSS

No.	AIRPORT & LOCATION	ID	OCD	PCI AVG & YR	PCI AVG & YR	AVG LOSS/YR
22	HARVEY FIELD (SNOHOMISH)	R1	1970	64 - 1986	N/A	
23	IONE MUNICIPAL	R1	1973	76 - 1986	76 - 1989	0
		R2	N/A	N/A	80 - 1989	
24	KELSO-LONGVIEW	R1	1983	90 - 1987	82 - 1991	2
25	KENNEWICK-VISTA FIELD	R1	1942	69 - 1987	N/A	
		R2	1942	68 - 1987	N/A	
26	LAKE CHELAN	R1	UNK	93 - 1988	N/A	
27	LIND AP	R1	1971	51 - 1987	51 - 1991	0
28	MANSFIELD	R1	1973	35 - 1988	N/A	
29	MOSES LAKE MUNICIPAL AP	R1	1961	89 - 1987	81 - 1991	2
		R2	1973	29 - 1987	18 - 1991	2.75
30	NEW WARDEN AP	R1	1977	77 - 1987	79 - 1991	SURVEY
31	OAK HARBOR AIR PARK	R1	1969	73 - 1988	N/A	
32	OCEAN SHORES	R1	1985	98 - 1986	95 - 1989	1
33	ODESSA MUNICIPAL	R1	1970	79 - 1987	46 - 1991	8.25
		R1A	1970	58 - 1987	50 - 1991	2
34	OKANAGAN LEGION AP	R1	1955	76 - 1987	N/A	
35	OLYMPIA AP	R1	1942	55 - 1988	45 - 1991	3.33
		R2	1980	89 - 1988	85 - 1991	1.33
		R3	1942	86 - 1988	84 - 1991	0.67
36	OMAK AP	R1	1943	68 - 1986	65 - 1989	1
37	OTHELLO MUNICIPAL	R1	UNK	79 - 1987	74 - 1991	1.25
		R2	N/A	N/A	90 - 1991	
38	PACKWOOD AP	R1	1975	94 - 1988	90 - 1991	1.33
39	PANGBORN FIELD (WENATCHEE)	R1	1947	63 - 1988	N/A	
		R2	1947	66 - 1988	N/A	
		R4	1947	55 - 1988	N/A	
		R5	1978	90 - 1988	N/A	
40	PEARSON AIRPARK (VANCOUVER)	R1	1966	58 -1987	58 - 1991	0
		R2	1966	84 - 1987	N/A	
41	PIERCE COUNTY (PUYALLUP)	R1	1958	64 -1986	98 -1989	AC OVLY, BS
42	PORT OF ILWACO	R1	1971	71 - 1986	49 - 1989	7.33
43	PORT OF WILLIPA HARBOR	R1	1948	72 - 1986	58 - 1989	4.67
	(RAYMOND)	R2	1948	68 - 1986	59 - 1989	3
44	PROSSER	R1	1977	88 - 1987	N/A	
45	PRU FIELD (RITZVILLE)	R1	1978	83 - 1987	77 - 1991	1.5
46	PULLMAN-MOSCOW REGIONAL AP	R1	1948	75 - 1986	70 - 1989	1.67
		R2	1968	70 - 1986	48 - 1989	7.33
		R3	1968	81 - 1986	68 - 1989	4.33
47	QUILLAYUTE	R1	UNK	72 - 1986	69 - 1989	1
48	QUINCY MUNICIPAL	R1	1977	72 - 1987	70 - 1991	0.5
		R2	1977	31 - 1987	N/A	

PCI DATA (WA) W/AVG LOSS

No.	AIRPORT & LOCATION	ID	OCD	PCI AVG & YR	PCI AVG & YR	AVG LOSS/YR
49	RICHLAND	R1	1943	86 - 1987	N/A	
		R2	1943	84 - 1987	N/A	
		R3	1979	86 - 1987	N/A	
50	ROSALIA MUNICIPAL	R1	1985	68 - 1987	49 - 1991	4.5
51	SAND CANYON (CHEWELAH)	R1	1974	88 - 1986	70 - 1989	6
52	SANDERSON FIELD (SHELTON)	R1	1942	77 - 1988	72 - 1991	1.67
53	SEKIU AP	R1	1972	68 - 1988	N/A	
		R2	1979	88 - 1988	N/A	
54	SEQUIM VALLEY	R1	1985	52 - 1988	42 - 1991	3.33
55	SKAGIT REGIONAL	R1	1942	69 - 1986	N/A	
		R2	1942	64 - 1986	N/A	
56	STORM FIELD (MORTON)	R1	1970	73 - 1988	83 - 1991	1.67
57	SUNNYSIDE	R1	1975	85 - 1987	N/A	
58	TACOMA NARROWS	R1	UNK	84 - 1987	83 - 1991	0.25
		R2	UNK	82 - 1987	81 - 1991	0.25
59	WALLA WALLA CITY/COUNTY AP	R1	1942	81 - 1987	N/A	
		R2	1942	58 - 1987	N/A	
		R4	1942	60 - 1987	N/A	
60	WATERVILLE	R1	1976	69 - 1986	N/A	
61	WHITMAN COUNTY MEM (COLFAX)	R1	1976	57 - 1986	40 - 1989	5.67
62	WILBUR	R1	1971	92 - 1986	83 - 1989	3
63	WILLIAM R. FAIRCHILD INT'L	R1	1942	79 - 1988	N/A	
		R2	1942	90 - 1988	N/A	
		R4	1942	94 - 1988	N/A	
64	WILLARD-TEKOA FIELD	R1	1975	90 - 1986	90 - 1989	0
65	WINLOCK (TOLEDO)	R1	1943	49 - 1986	42 - 1989	2.33
66	WOODLAND STATE	R1	1984	91 - 1987	88 - 1991	0.75
67	FRIDAY HARBOR	R1	UNK	90 - 1988	N/A	
68	GOLDENDALE	R1	UNK	87 - 1989	N/A	
69	OROVILLE	R1	UNK	79 - 1987	N/A	
70	WENTHROP	R1	UNK	73 - 1988	N/A	

WASHINGTON AIRPORT PAVEMENT CHARACTERISTICS

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RPD	EXISTING STRUCTURE
1	ANACORTES AP	R1	1968	DBST,7.5"B	1973	2"AC OL,DBST,7.5"B
		R2	1968	DBST, 7.5"B	1973	2"AC, 3"B,7"SB
		R3	1968	DBST, 7.5"B	1973	2"AC, 4"B, 6"SB
2	ARLINGTON MUNICIPAL AP	R1	1942	2"AC, 6"B		2" AC, 6"B
		R2	1942	3"AC, 8"B	1976	2"AC OL, 3"AC, 8"B
3	AUBURN MUNICIPAL AP	R1	1968	2"AC, 18"B		2"AC, 18"B
		R2	1983	2"AC, 3"B, 11"SB		2"AC, 3"B, 11"SB
4	BLAINE MUNICIPAL AP	R1	1972	2"AC, 8"B		2"AC, 8"B
5	BOWERMAN FIELD, HOQUIAM	R1	1943	2.5"AC, 12"B		2.5"AC, 12"B
		R2	1943	8"-6"-8"PCC		8"-6"-8"PCC
		R3	1943	8"-6"-8"PCC		8"-6"-8"PCC
6	BOWERS FIELD, ELLENSBURG	R1	1976	3"AC, 6.5"B		3"AC, 6.5B
		R1A	1942	3.5"AC, 6"B		3.5"AC, 6"B
		R2	1942	3"AC, 6.5"B		3"AC, 6.5"B
		R3	1942	2.5"AC, 6"B		2.5"AC, 6"B
		R4	1942	2.5"AC, 3"B, 5"SB		2.5"AC, 3"B, 5"SB
7	BREMERTON NATIONAL	R1	1942	2.5"AC, 6"B	1974	3"AC OL, 2.5"AC,6"B
		R2	1942	3"AC, 2.5"B, 6"SB	1974	5"AC OL,3"AC,2.5"B,6"SB
		R3	1942	5"AC, 4"B, 6"SB	1983	5"AC, 4"B, 6"SB + CR. SL.
		R4	1942	3"AC, 4"B, 6"SB	1974	2"AC OL, 3"AC, 4"B, 6"SB
		R5	1942	2.5"AC, 6"B		2.5"AC, 6"B
8	CASHMERE - DRYDEN AP	R1	1951	TBST, 9"B	1979	DBST, TSC, TBST, 9"B
9	CHEHALIS - CENTRALIA AP	R1	1942	8"-6"-8"PCC, 6"SB		8"-6"-8"PCC, 6"SB
		R2	1942	8"-6"-8"PCC, 6"SB		8"-6"-8"PCC, 6"SB
10	CLE ELUM MUNICIPAL AP	R1	1987	TBST, 4"B		TBST, 4"B
11	COLVILLE MUNICIPAL AR	R1	1949	DBST, 8"B	1958	SC, DBST, 8"B
12	CONCRETE MUNICIPAL	R1	1974	DBST, 2"B, 4"SB		DBST, 2"B, 4"SB
13	CONNELL CITY AP	R1	1970	BST, ?"B	1979	2"AC OL, BST, ?"B
14	CREST AP, KENT	R1	1967	BST, GRAVEL	1986	2"AC OL, BST, GRAVEL
15	DAVENPORT AP	R1	1973	BST, 8"PRB	1984	TBST, 8"B

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RRD	EXISTING STRUCTURE
16	DEER PARK AP	R1	1943	1.5"AC, 6"B		1.5"AC, 6"B
		R2	1976	2"AC, 6"B		2"AC, 6"B
		R3	1943	1.5"AC, 6"B		1.5"AC, 6"B
17	ELMA MUNICIPAL AP	R1	1976	1.5"AC, 3"B		1.5"AC, 3"B
18	EPHRATA MUNICIPAL	R1	1943	6"PCC, 6"SB		6"PCC, 6"SB
		R1A	1943	3"AC, 6"B	1970	SS, 3"AC, 6"B
		R2	1943	2.5"AC, 6"B	1970	SS, 2.5"AC, 6"B
		R2A	1943	6"PCC, 6"SB		6"PCC, 6"SB
		R2B	1983	3"AC, 7"B, 12"SB		3"AC, 7"B, 12"SB
19	EVERGREEN FIELD, VANCOUVER	R1	1967	2"AC, 4"B		2"AC, 4"B
		R2	1971	2"AC, 4"B		2"AC, 4"B
20	FERRY COUNTY (REPUBLIC) AP	R1	1974	BST, 5"B, 6"SB	1978	CS, BST, 5"B, 6"SB
21	GRAND COULY DAM AP	R1	1972	BST, 6"B	1980	2"AC OL, BST, 6"B
	(ELECTRIC CITY)	R2	1980	2"AC, 5"B		2"AC, 5"B
22	HARVEY FIELD (SNOHOMISH)	R1	1970	2"AC, 12"B	1982	SC, 2"AC, 12"B
23	IONE MUNICIPAL	R1	1973	BST, 4"B, 8"PRB	UNK	TBST,4"CB, 8"PRB
		R2	UNK	UNK	1989	DBST, 4"CB, 10"PRB
24	KELSO-LONGVIEW	R1	1983	3"AC, 5"B, 9"SB		3"AC, 5"B, 9"SB
25	KENNEWICK-VISTA FIELD	R1	1942	2"AC, 6"B	1976	CS, 2"AC, 6"B
		R2	1942	2"AC, 6"B		2"AC, 6"B
26	LAKE CHELAN	R1	UNK	UNK	1986	2"AC, 5"B
27	LIND AP	R1	1971	DBST, 3"B	1982	SS, SS, DBST, 3"B
28	MANSFIELD	R1	1973	BST, 4"B	1983	CS, CS, BST, 4"B
29	MOSES LAKE MUNICIPAL AP	R1	1961	DBST, 6"B	1984	2"AC OL, SS, DBST, 6"B
		R2	1973	.75"AC, ?"B		.75"AC, ?"B
30	NEW WARDEN AP	R1	1977	2"AC, 6"B		2"AC, 6"B
31	OAK HARBOR AIR PARK	R1	1969	SC, 3"B, 7"SB	1971	2"AC OL, SC, 3"B, 7"SB
32	OCEAN SHORES	R1	1985	DBST, 8"B		DBST, 8"B
33	ODESSA MUNICIPAL	R1	1970	DBST, 3"B	1985	DBST, 6"B - RECONSTR.
		R1A	1970	DBST, 3"B	1985	TBST, 3"B

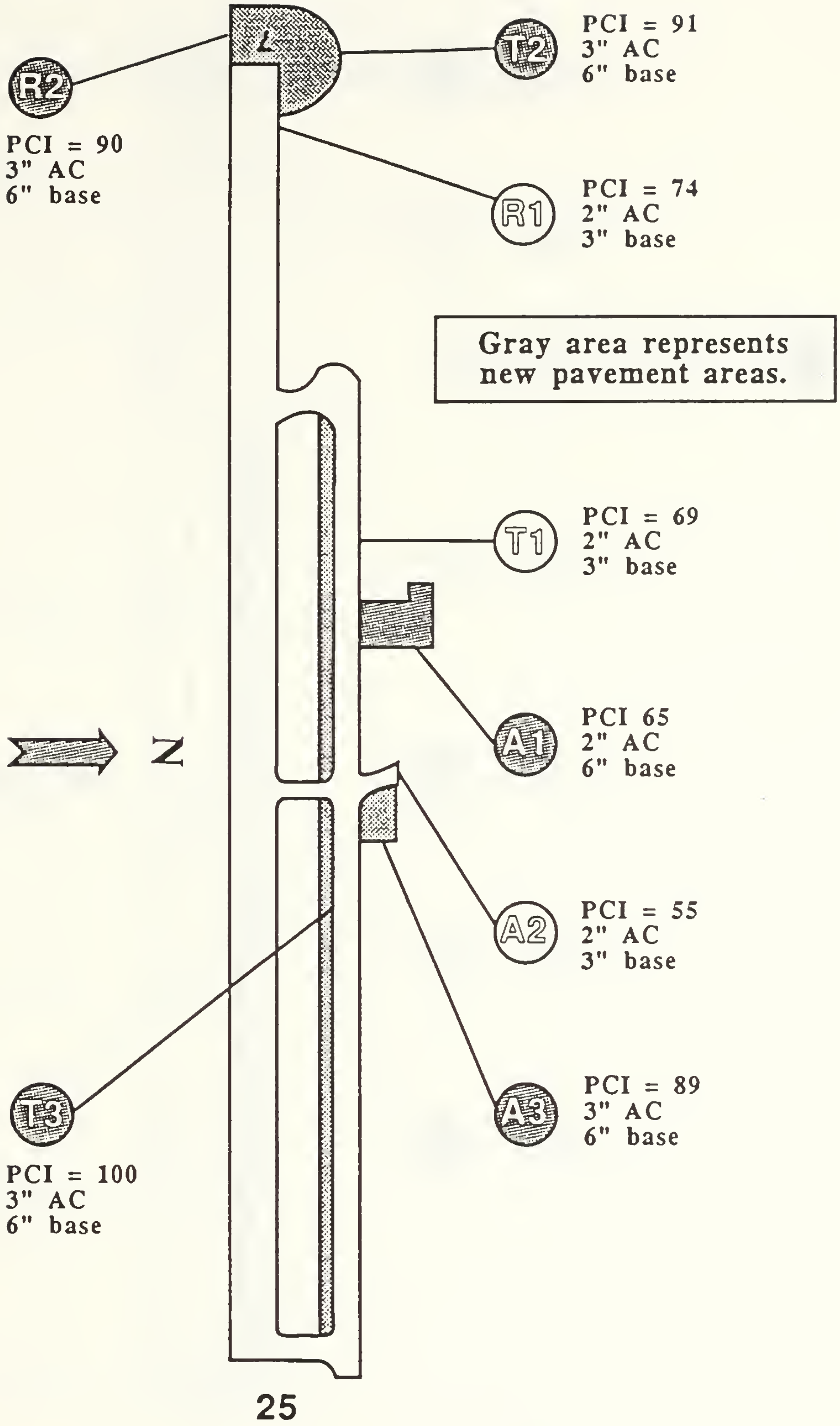
No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RRD	EXISTING STRUCTURE
34	OKANAGAN LEGION AP	R1	1955	BST, 2"B	1987	DBST,BST,BST, BST, 2"B
35	OLYMPIA AP	R1	1942	2.5"AC, 6"B		2.5"AC, 6"B
		R2	1980	3"AC, 10"B, 6"SB		3"AC, 10"B, 6"SB
		R3	1942	2.5"AC, 6"B	1980	3"AC OL, 2.5"AC, 6"B
36	OMAK AP	R1	1943	4.5"AC, 12"B	1974	2.5"AC OL, 4.5"AC, 12"B
37	OTHELLO MUNICIPAL	R1	UNK	BST, 3"B	1976	2"AC OL, BST, 3"B
		R2	UNK	UNK	1991	3"AC, 6"B
38	PACKWOOD AP	R1	1975	BST, GRAVEL	1985	2"AC,2"B, BST, GRAVEL
39	PANGBORN FIELD (WENATCHEE)	R1	1947	2"AC, 7"B	1974	CS, 2"AC, 7"B
		R2	1947	3"AC, 8"B	1974	CS, 3"AC, 8"B
		R4	1947	2"AC, 7"B		2"AC, 7"B
		R5	1978	3"AC, 6"B		3"AC, 6"B
40	PEARSON AIRPARK (VANCOUVER)	R1	1966	1.5"AC, ?"B	1975	CS, 1.5"AC, ?"B
		R2	1966	1.5"AC, ?"B	1975	CS, 1.5"AC, ?"B
41	PIERCE COUNTY (PUYALLUP)	R1	1958	1.5"AC, 2"CB, GSB	1988	2"AC, 4"CB, 6"SB - REDEV.
42	PORT OF ILWACO	R1	1971	1.5"AC, GRAVEL		1.5"AC, GRAVEL BASE
43	PORT OF WILLIPA HARBOR	R1	1948	BST, 3"BSB, 5"SB	1976	1"AC OL, 3"BSB, 5"SB
	(RAYMOND)	R2	1948	BST, 3"BSB, 7"SB	1976	1.25"AC OL, 3"BSB, 7"SB
44	PROSSER	R1	1977	2"AC, 6"B, 1.5"SB	1981	CS, 2"AC, 6"B, 1.5"SB
45	PRU FIELD (RITZVILLE)	R1	1978	TBST, ?"B	1985	SC, TBST, ?"B
46	PULLMAN-MOSCOW REGIONAL AP	R1	1948	2"AC, 8"B, 7"SB	1972	2"AC OL, 2"AC, 8"B, 7"SB
		R2	1968	3"AC, 15.5"B	1985	3"AC, 15.5"B - GROOVED
		R3	1968	4"AC, 19"SB	1985	4"AC, 19"SB - GROOVED
47	QUILLAYUTE	R1	UNK	6"PCC		6"PCC
48	QUINCY MUNICIPAL	R1	1977	BST, 3"B	1980	SS, BST, 3"B
		R2	1977	BST, 3"B		BST, 3"B
49	RICHLAND	R1	1943	2"AC, 6"B	1979	2"AC OL, 2"AC, 6"B
		R2	1943	2"AC, 8"B	1979	2"AC OL, 2"AC, 8"B
		R3	1979	3"AC, 3"B, 4"SB		3"AC, 3"B, 4"SB
50	ROSALIA MUNICIPAL	R1	1985	SS, BST, 3"B,3.5"SB		SS, BST, 3"B, 3.5"SB
51	SAND CANYON (CHEWELAH)	R1	1974	SS,1"AC,DBST,12"CB		SS, 1"AC, DBST, 12"CB

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RRD	EXISTING STRUCTURE
52	SANDERSON FIELD (SHELTON)	R1	1942	2"AC, 6"B	1979	SS, 2"AC, 6"B
53	SEKIU AP	R1	1972	2"AC, 6"B	1987	CS, SAND SL, 2"AC, 6"B
		R2	1979	2"AC, 6"B	1987	CS, SAND SL, 2"AC, 6"B
54	SEQUIM VALLEY	R1	1985	DBST, 12"PRG		DBST, 12"PRG
55	SKAGIT REGIONAL	R1	1942	2"AC, 4"B, 6"SB		2"AC, 4"B, 6"SB
		R2	1942	2"AC, 4"B, 12"SB		2"AC, 4"B, 12"SB
56	STORM FIELD (MORTON)	R1	1970	BST, BASE	1987	TBST, BASE
57	SUNNYSIDE	R1	1975	3"AC, 6"B	1985	SS, 3"AC, 6"B
58	TACOMA NARROWS	R1	UNK			2.5"AC, 8"B, 3"SB
		R2	UNK			2"AC, 7"B, 3"SB
59	WALLA WALLA CITY/COUNTY AP	R1	1942	6.5"PCC, 6"SB	1970	1.5"AC,1"PFC,6.5"PCC,6"SB
		R2	1942	6.5"PCC, 6"SB		6.5"PCC, 6"SB
		R4	1942	6.5"PCC, 6"SB		6.5"PCC, 6"SB
60	WATERVILLE	R1	1976	BST, 6"B	1983	SC, BST, 6"B
61	WHITMAN COUNTY MEM (COLFAX)	R1	1970	BST, 6"B	1981	SS, BST, 6"B
62	WILBUR	R1	1971	BST, 6"B	1985	2"AC OL, SC, BST, 6"B
63	WILLIAM R. FAIRCHILD INT'L	R1	1942	2"AC, 6"AB	1979	2"AC OL, SS, 2"AC, 6"AB
	(PORT ANGELES)	R2	1942	2"AC, 6"AB	1979	2"AC OL, SS, 2"AC, 6"AB
		R4	1942	2"AC, 6"AB	1978	2"AC OL, SS, 2"AC, 6"AB
64	WILLARD-TEKOA FIELD	R1	1975	2"AC, 4"B, 12"SB		2"AC, 4"B, 12"SB
65	WINLOCK (TOLEDO)	R1	1943	2"AC, 8"B		2"AC, 8"B
66	WOODLAND STATE	R1	1984	TBST, ?"B		TBST, ?"B
67	FRIDAY HARBOR	R1	UNK	UNK		2"AC, 3"B, 4"SB
68	GOLDENDALE	R1	UNK	UNK		2+"AC, 12"B
69	OROVILLE	R1	UNK	UNK		2"AC, 3"B
70	WENTHROP	R1	UNK	UNK		1+"AC, ?"B

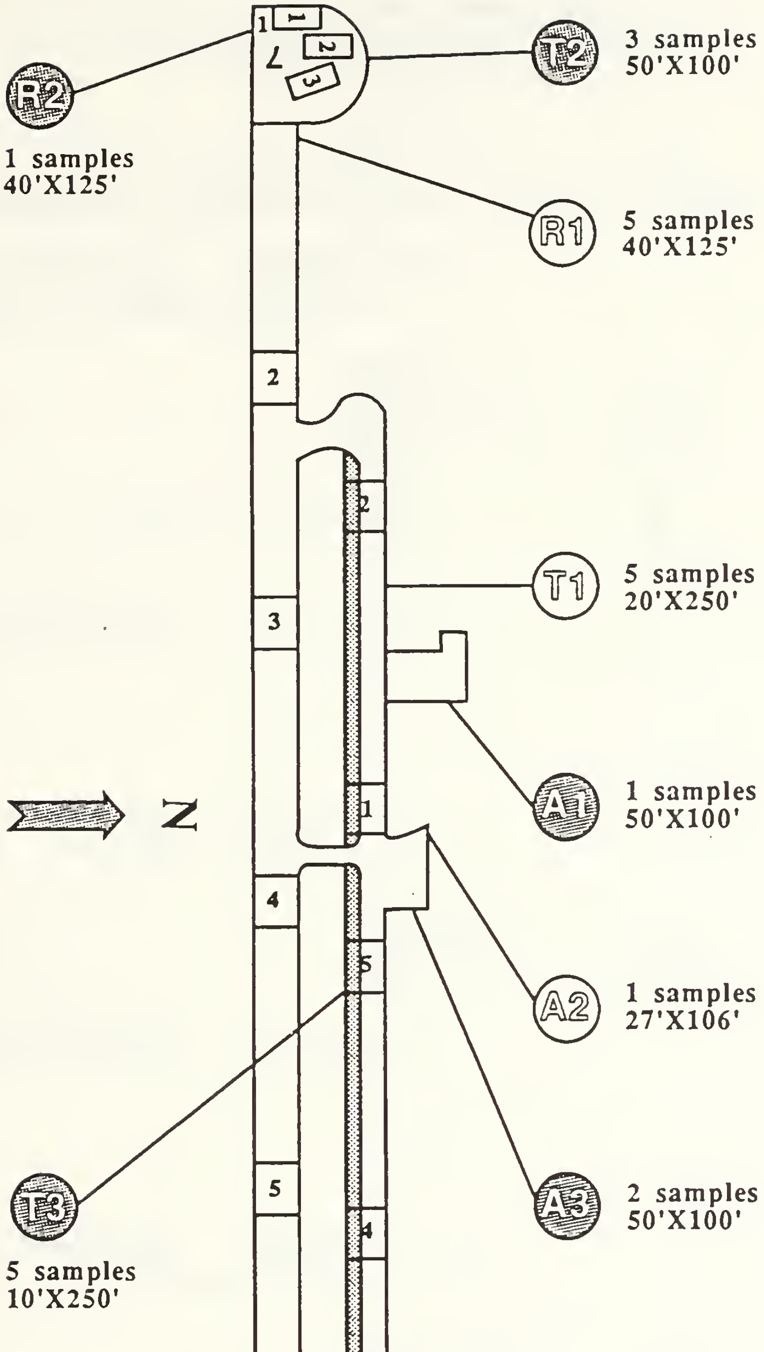
OTHELLO MUNICIPAL AIRPORT, WASHINGTON

PAVEMENT FEATURES
&
PAVEMENT CONDITION SURVEY

MAY 20, 1991



Othello Municipal Airport
Pavement features and PCI numbers
May 20, 1991.



Othello Municipal Airport
Location of sample areas within each feature
May 20, 1991

Feature Summaries
Othello Municipal Airport
Othello Port District

Date of Survey: May 20, 1991
By: Frederick N. Mills Jr. and Robert O. Brown

Airport Facility: Runway R-1
Total No. of Sample Units: 5

Sample Unit No.	Sample Unit Area	PCI
1	5000	73
2	5000	75
3	5000	55
4	5000	92
5	5000	74

Average PCI: 74
Condition Rating: Very Good

* * *

Airport Facility: Runway R-2
Total No. of Sample Units: 5

Sample Unit No.	Sample Unit Area	PCI
1	5000	90

Average PCI: 90
Condition Rating: Excellent

* * *

Airport Facility: Taxiway T-1
Total No. of Sample Units: 5

Sample Unit No.	Sample Unit Area	PCI
1	5000	33
2	5000	78
3	5000	69
4	5000	80
5	5000	87

Average PCI: 69
Condition Rating: Good

Airport Facility: Turnaround Taxiway T-2
Total No. of Sample Units: 3

Sample Unit No.	Sample Unit Area	PCI
1	5000	90
2	5000	93
3	5000	91

Average PCI: 91
Condition Rating: Excellent

* * *

Airport Facility: Taxiway T-3
Total No. of Sample Units: 5

Sample Unit No.	Sample Unit Area	PCI
1	2500	100
2	2500	100
3	2500	100
4	2500	100
5	2500	100

Average PCI: 100
Condition Rating: Excellent

* * *

Airport Facility: Apron A-1
Total No. of Sample Units: 1

Sample Unit No.	Sample Unit Area	PCI
1	5000	65

Average PCI: 65
Condition Rating: Good

* * *

Airport Facility: Apron A-2
Total No. of Sample Units: 1

Sample Unit No.	Sample Unit Area	PCI
1	2862	55

Average PCI: 55
Condition Rating: Fair

* * *

Airport Facility: Apron A-3
Total No. of Sample Units: 2

Sample Unit No.	Sample Unit Area	PCI
1	5000	86
2	5000	92

Average PCI: 89
Condition Rating: Excellent

* * *

Principal Distresses

Runway: Longitudinal and transverse cracking; ravelling and depressions.

Taxiway: Alligator; block; longitudinal and transverse cracking; depressions and ravelling.

Apron: A-2 (former fuel pump taxiway) Block; longitudinal and trasverse cracking; depressions and ravelling.

Othello Municipal Airport
Pavement Development and Maintenance

In 1975 a paved runway existed to some degree consisting of a 3" gravel base with an oil penetration surface (probably means a BST surface). In 1976 the runway was overlaid with a 2" AC surface and was extended. A parallel taxiway and very small apron were constructed. In 1987 it was reported that all pavements appeared to be a 2" AC surface on a 3" crushed aggregate base.

In 1989 several improvements were made: The parallel taxiway was widened from 20' to 30' (3" AC on 7" crushed aggregate base); A runway 7 turnaround was constructed that also resulted in approximately 125' of new runway (3" AC on a 7" crushed aggregate base); two new aprons were constructed (2" AC on 4" base); and approximately 15,000 linear feet of crack sealing was accomplished.

The airport remains a very active agricultural applicator airport with two ag operators on the field. There is reportedly a fair amount of light twin and single engine GA traffic, also. While the runway is at present in good condition, the center 20' appears to be a different mix than the 10' outer lanes on each side. The outer lanes show some ravelling while the center 20' does not. Crackfilling is needed and a fog seal, particularly on the outer lanes, this would help the ravelling condition. Eventually it would be desirable to widen the runway to 60' and overlay the existing 40' width. The old portion of parallel taxiway needs crackfilling and an overlay, and the existing runway exit taxiways should be widened to a minimum of 30' and the older portion overlaid. An Additional apron adjoining the apron work accomplished in 1989 would be desirable in addition to overlaying the older section (former taxiway) running south from the existing fuel pumps and adjoining the east/west taxiway.

Planning Considerations

In 1989 a dirt bank running approximately 800' west of the west edge of the west runway exit taxiway was partially removed and the remaining part graded to a 5:1 slope, creating a 75' from runway centerline (C/L) safety area. While this is a significant improvement it is recommended that widening continue to a minimum of 100' (125' desirable) from runway C/L.

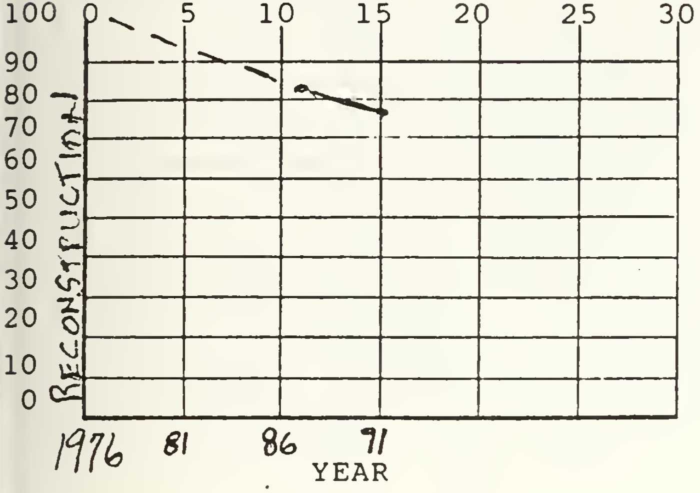
PAVEMENT CONDITION TREND

AIRPORT: OTHELLO MUNICIPAL AIRPORT

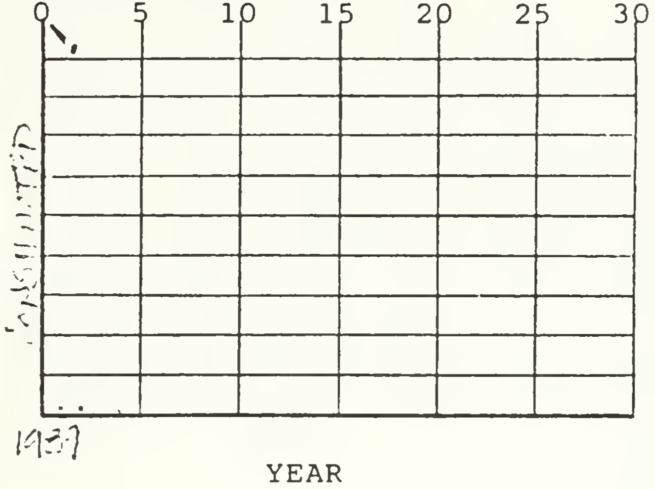
DATE OF LAST SURVEY: 5-20-91

NOTES: PCI NUMBER indicates PAVEMENT CONDITION INDEX
Horizontal scale covers 30 yrs.
Year 0 is year of original construction, major reconstruct. or overlay

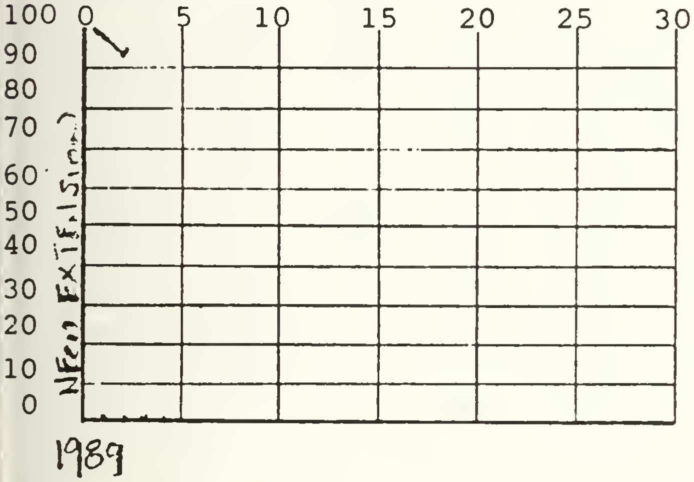
AIRPORT FACILITY: R-1



AIRPORT FACILITY: T-2



AIRPORT FACILITY: R-2



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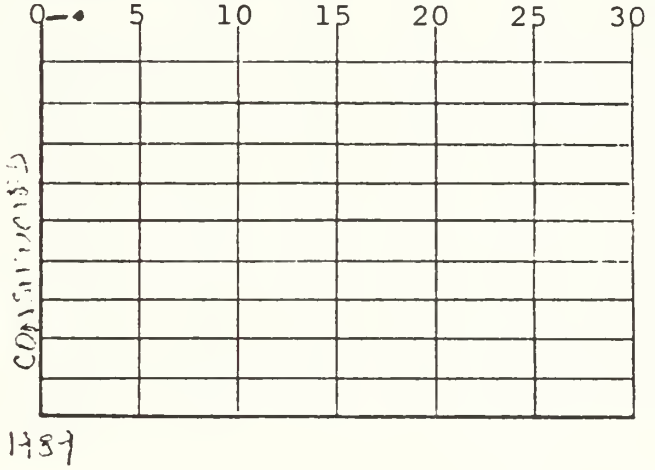
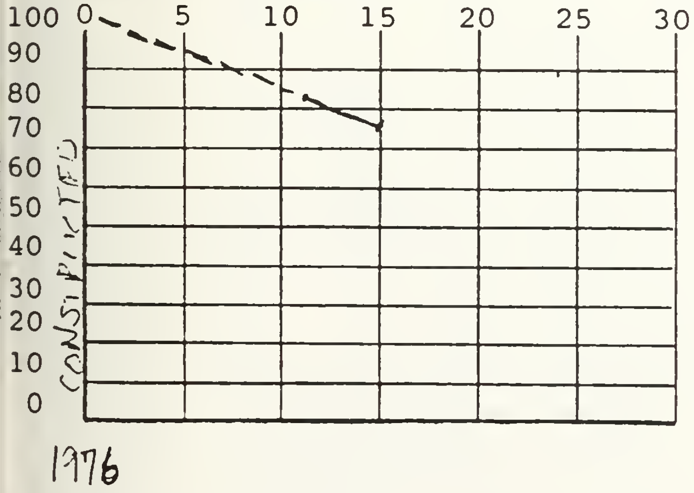
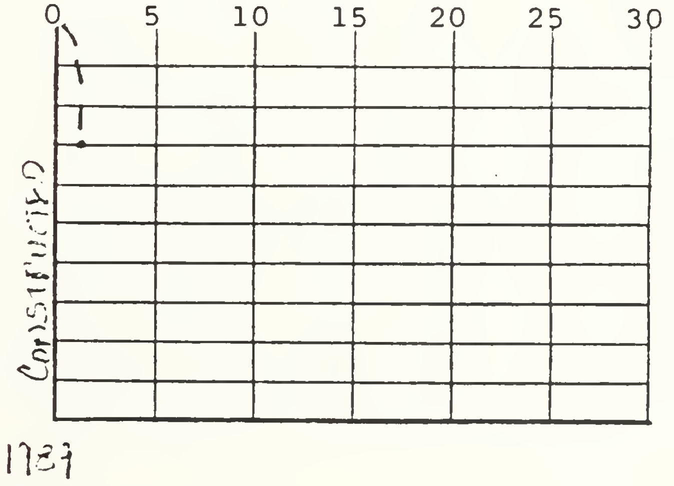


AIRPORT FACILITY: T-1



AIRPORT FACILITY: A-1



12

PAVEMENT CONDITION TREND

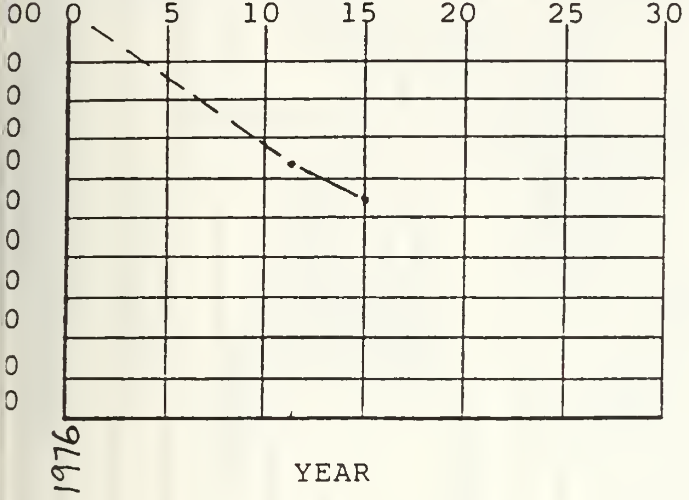
AIRPORT: OTHELLO Municipal Airport

DATE OF LAST SURVEY: 5-20-91

NOTES: PCI NUMBER indicates

PAVEMENT CONDITION INDEX
Horizontal scale covers 30 yrs.
Year 0 is year of original construction, major reconstruct. or overlay

AIRPORT FACILITY: A-2



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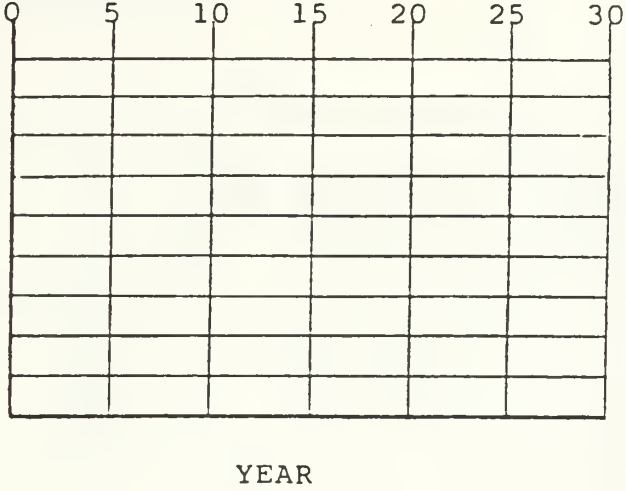
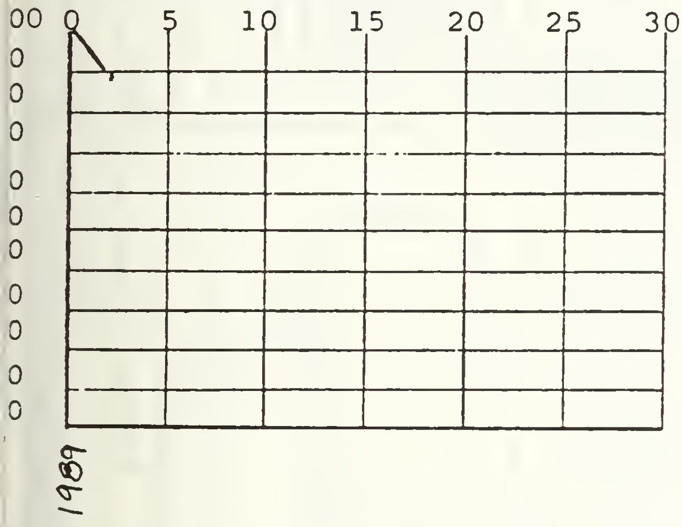


AIRPORT FACILITY: A3



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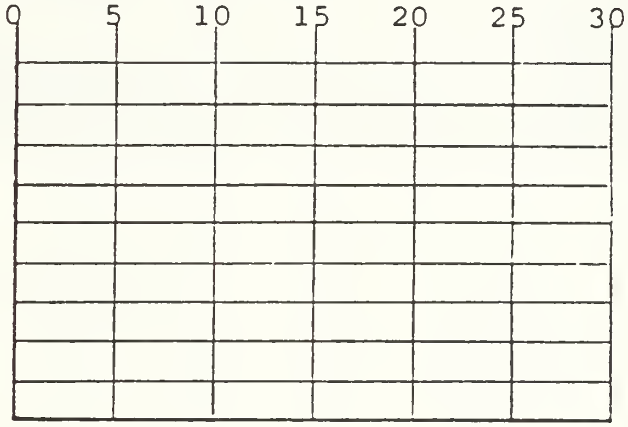

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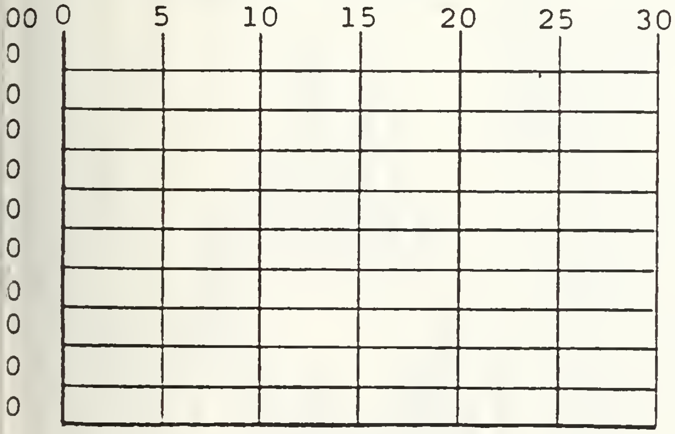

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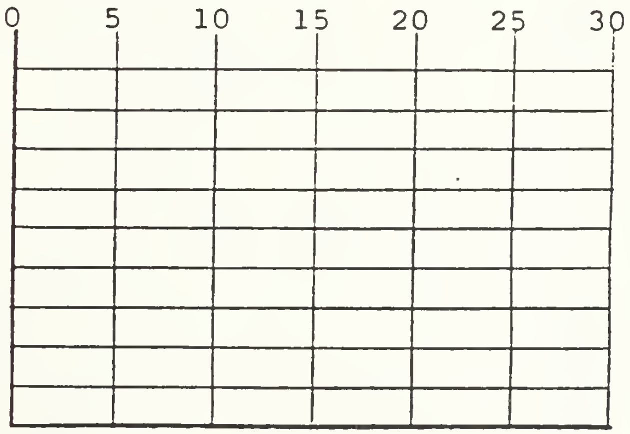


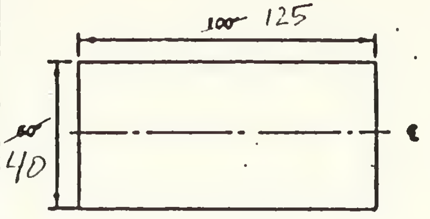
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT Othello Municipal Airport
DATE 5-20-81
FACILITY RWY 7-25
FEATURE R1
SAMPLE UNIT 1
SURVEYED BY FM/PP
AREA OF SAMPLE 5000

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	5	8	12			
	250 L	120 L	10% M			
TOTAL SEVERITY L	250'	120'				
M			10%			
H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	5.0	14
8	L	2.4	8
12	M	10.0	20
DEDUCT TOTAL			47
CORRECTED DEDUCT VALUE (CDV)			27

q = 3

PCI = 100 − CDV = 73

RATING = Very Good

FLEXIBLE PAVEMENT

CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT
DATE
FACILITY
FEATURE R1
SAMPLE UNIT 2
SURVEYED BY
AREA OF SAMPLE

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

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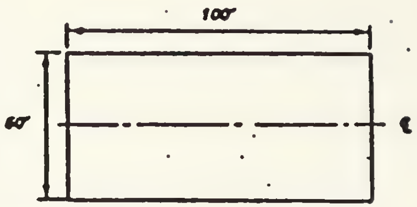

EXISTING DISTRESS TYPES

	8	5	12			
	180 L	30' L	10% M			
	20 M	90 M				
TOTAL SEVERITY L	180'	30 SF				
M	20'	90 SF	10%			
H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	0.6	3
5	M	1.8	20
8	L	3.6	11
8	M	0.4	7
12	M	10%	10
DEDUCT TOTAL			51
CORRECTED DEDUCT VALUE (CDV)			25

q = 4

PCI = 100 − CDV = 75

RATING = Very Good

FLEXIBLE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT Othello Municipal Airport
DATE 5-20-91
FACILITY RWY 7-25
FEATURE R1
SAMPLE UNIT 3
SURVEYED BY FM/RB
AREA OF SAMPLE 5000

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

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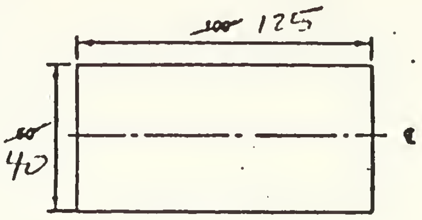

EXISTING DISTRESS TYPES

		5	8	12	1		
		140L	200 L	5% M	20 L		
		140M	15M				
TOTAL SEVERITY	L	140'	200'		20 SF		
	M	140'	15'	5% M			
	H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
1	L	0.4	12
5	L	2.9	14
5	M	2.8	24
8	L	4.0	13
8	M	0.3	6
12	M	5.0	16
DEDUCT TOTAL			85
CORRECTED DEDUCT VALUE (CDV)			45

✓

PCI = 100 − CDV = 55

RATING = FAIR

FLEXIBLE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT
DATE
FACILITY
FEATURE R1
SAMPLE UNIT 4
SURVEYED BY
AREA OF SAMPLE

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

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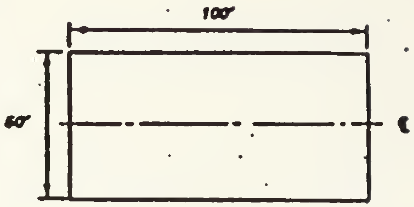

EXISTING DISTRESS TYPES

		5	8	12			
		20'L	120L	5.0			
TOTAL SEVERITY	L	20 SF	120	5%			
	M						
	H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	l	0.4	2
8	l	2.4	8
12	l	5.0	7
DEDUCT TOTAL			17
CORRECTED DEDUCT VALUE (CDV)			8

✓

PCI = 100 − CDV = 92

RATING = EXCELLENT

CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT Othello Municipal Airport

DATE 5-20-91

FACILITY RWY 7-25

FEATURE R1

SAMPLE UNIT 5

SURVEYED BY FM/RB

AREA OF SAMPLE 5000

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

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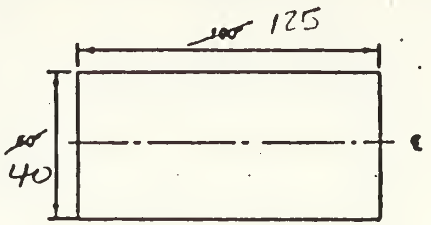


EXISTING DISTRESS TYPES

▨	3	5	8	12		
▨	10L	200L	120L	4.0		
▨	40M		15M			
▨						
▨						
▨						
▨						
▨						
▨						
TOTAL SEVERITY L	10	200	120	4%		
TOTAL SEVERITY M	40		15			
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
3	L	0.2	5
3	M	0.8	11
5	L	4.0	17
8	L	2.4	8
8	M	0.3	6
12		4.0	7
DEDUCT TOTAL			54
CORRECTED DEDUCT VALUE (CDV)			26

PCI = 100 − CDV = 74

RATING = Very Good

FLEXIBLE PAVEMENT

CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT

DATE

FACILITY

FEATURE

SAMPLE UNIT

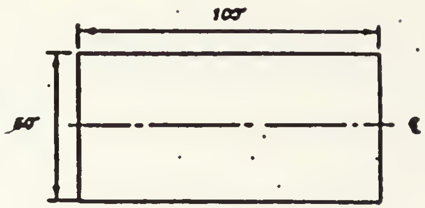
SURVEYED BY

AREA OF SAMPLE

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

▨						
▨						
▨						
▨						
▨						
▨						
▨						
▨						
▨						
TOTAL SEVERITY L						
TOTAL SEVERITY M						
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
DEDUCT TOTAL			
CORRECTED DEDUCT VALUE (CDV)			

PCI = 100 − CDV =

RATING =

CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT Ottumwa Municipal Airport

DATE 5-20-91

FACILITY Runway

FEATURE R2

SAMPLE UNIT 1

SURVEYED BY FM

AREA OF SAMPLE 5000

DISTRESS TYPES

1. ALLIGATOR CRACKING	10. PATCHING
2. BLEEDING	11. POLISHED AGGREGATE
3. BLOCK CRACKING	12. RAVELING/WEATHERING
4. CORRUGATION	13. RUTTING
5. DEPRESSION	14. SHOVING FROM PCC
6. JET BLAST	15. SLIPPAGE CRACKING
7. JT. REFLECTION (PCC)	16. SWELL
8. LONG. & TRANS. CRACKING	
9. OIL SPILLAGE	

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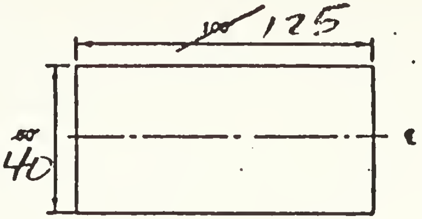

EXISTING DISTRESS TYPES

	5	8	12			
	30L	21L	2.0			
TOTAL SEVERITY L	30	21	2.0			
TOTAL SEVERITY M						
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	0.6	3
8	L	0.4	3
12	L	2.0	4

DEDUCT TOTAL 10

CORRECTED DEDUCT VALUE (CDV) 10

PCI = 100 − CDV = 90

RATING = Excellent

FLEXIBLE PAVEMENT

CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT

DATE

FACILITY

FEATURE T2

SAMPLE UNIT 1

SURVEYED BY

AREA OF SAMPLE 5000

DISTRESS TYPES

1. ALLIGATOR CRACKING	10. PATCHING
2. BLEEDING	11. POLISHED AGGREGATE
3. BLOCK CRACKING	12. RAVELING/WEATHERING
4. CORRUGATION	13. RUTTING
5. DEPRESSION	14. SHOVING FROM PCC
6. JET BLAST	15. SLIPPAGE CRACKING
7. JT. REFLECTION (PCC)	16. SWELL
8. LONG. & TRANS. CRACKING	
9. OIL SPILLAGE	

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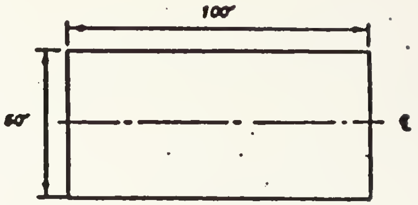

EXISTING DISTRESS TYPES

	8	12				
	33'L	1.0				
TOTAL SEVERITY L	33L	1.0				
TOTAL SEVERITY M						
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
8	L	0.7	5
12	L	1.0	2

DEDUCT TOTAL 7

CORRECTED DEDUCT VALUE (CDV) 7

PCI = 100 − CDV = 93

RATING = Excellent

APPENDIX B

OREGON STATE
GENERAL AVIATION
PAVEMENT CONDITION SURVEY DATA

INCLUDING:

1) AIRPORT LOCATION/DESCRIPTION/SECTION DATA
2) PAVEMENT IDENTIFICATION & CHARACTERISTICS
3) AVERAGE PCI VALUES FOR PAVEMENT FEATURES
4) PAVEMENT CONDITION SURVEY DATES
5) AVERAGE PCI LOSS WITH AGE
6) REPAIR AND REHABILITATION INFORMATION
7) TILLAMOOK AIRPORT COMPLETE PCI SURVEY

****

APPENDIX LEGEND

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ID	Runway/Feature Identification Number
OCD	Original Construction Date
PCI	Pavement Condition Index
AVG	Average
YR	Year
RRD	Ruway Rehabilitation Date
ORIG	Original
STRUC.	Structural
SEC.	Section
SURVEY	PCI Inceased Value Attributed To Survey Conducted

PCI LOSS DATA (OR)

No.	AIRPORT & LOCATION	ID	OCD	PCI AVG & YR	PCI AVG & YR	AVG LOSS/YR
1	ALBANY MUNICIPAL AP	R1	1959	99 - 1988	N/A	
2	ASHLAND MUNICIPAL	R1	1965	91 - 1987	89 - 1991	0.5
		R2	1985	92 - 1987	88 - 1991	1
3	AURORA STATE AP	R1	1975	85 - 1986	N/A	
4	BAKER MUNICIPAL AP	R2	1942	66 - 1986	N/A	
		R3	1942	69 - 1986	N/A	
		R4	1983	88 - 1986	N/A	
5	BANDON STATE AP	R1	1966	72 - 1986	N/A	
6	BEND MUNICIPAL	R1	1977	80 - 1986	N/A	
		R2	1977	89 - 1986	N/A	
7	BOARDMAN AP	R1	1943	57 - 1988	N/A	
8	BROOKINGS STATE	R1	1968	90 - 1986	N/A	
		R2	1968	90 - 1986	N/A	
9	BURNS MUNICIPAL AP	R1	1942	50 - 1986	N/A	
		R2	1942	49 - 1986	N/A	
10	CHILOQUIN STATE AP	R1	1961	25 - 1987	N/A	
11	CHRISTMAS VALLEY AP	R1	1985	90 - 1987	86 - 1991	1
12	CONDON STATE AP	R1	1986	94 - 1987	78 - 1991	4
13	CORVALLIS MUNICIPAL AP	R1	1942	93 - 1988	N/A	
		R2	1942	55 - 1988	N/A	
14	COTTAGE GROVE AP	R1	1966	83 - 1988	N/A	
		R2	1970	85 - 1988	N/A	
15	COUNTY SQUIRE AIRPARK	R1	1976	70 - 1988	N/A	
16	CRESWELL MUNICIPAL AP	R1	1987	98 - 1988	N/A	
17	FLORENCE MUNICIPAL AP	R1	1968	95 - 1988	N/A	
18	GOLD BEACH MUNICIPAL	R1	1964	90 - 1986	N/A	
19	HERMISTON MUNICIPAL	R1	1959	80 - 1988	N/A	
		R2	1977	87 - 1988	N/A	
20	HOOD RIVER AP	R1	1986	96 - 1987	92 - 1991	1
		R2	1986	95 - 1987	90 - 1991	1.25
		R3	1986	91 - 1987	91 - 1991	0
21	INDEPENDENCE STATE AP	R1	1974	91 - 1986	N/A	
22	ILLINOIS VALLEY AP	R1	1953	87 - 1987	83 - 1991	1
		R2	1960	93 - 1987	91 - 1991	0.5
23	JOHN DAY STATE AP	R1	1962	68 - 1986	N/A	
		R3	1982	93 - 1986	N/A	
24	JOSEPHINE STATE/COUNTY AP	R1	1966	72 - 1986	81 - 1991	CHECK
25	LA GRANDE MUNICIPAL AP	R1	1942	51 - 1986	N/A	
		R2	1942	72 - 1986	N/A	
		R3	1974	88 - 1986	N/A	
26	LAKE COUNTY AP	R1	1943	71 - 1987	68 - 1991	0.75
27	LEXINGTON AP	R1	1965	69 - 1987	88 - 1991	CHECK
28	LEBANON STATE AP	R1	UNK	88 - 1988	N/A	
		R2	1972	89 - 1988	N/A	

PCI LOSS DATA (OR)

No.	AIRPORT & LOCATION	ID	OCD	PCI AVG & YR	PCI AVG & YR	AVG LOSS/YR
29	MADRAS CITY-COUNTY AP	R1	1943	84 - 1986	95 - 1991	CHECK
		R2	1943	16 - 1986	98 - 1991	"
		R3	1943	46 - 1986	N/A	
		R4	1943	39 - 1986	N/A	
30	MCDERMITT STATE AP	R1	1985	96 - 1986	N/A	
31	MCMINNVILLE MUNICIPAL AP	R1	1943	56 - 1988	N/A	
		R2	1943	61 - 1988	N/A	
32	NEWHALAM BAY STATE AP	R1	1965	80 - 1987	77 - 1991	0.75
33	NORTH BEND MUNICIPAL	R1	1943	90 - 1988	N/A	
		R2	1943	88 -1988	N/A	
		R2A	1943	90 - 1988	N/A	
		R3	1943	75 - 1988	N/A	
34	OAKRIDGE STATE AIRPORT	R1	N/A	N/A	70 - 1991	
35	ONTARIO MUNICIPAL	R1	1978	84 - 1986	N/A	
36	OREGON CITY AIRPARK	R1	1972	45 - 1988	N/A	
37	PACIFIC CITY-STATE AP	R1	1950	79 - 1987	75 - 1991	1
38	PINEHURST STATE AP	R1	1956	83 - 1987	76 - 1991	1.75
39	PENDLETON MUNICIPAL	R1	1942	98 - 1988	N/A	
		R2	1942	97 - 1988	N/A	
		R3	1942	82 - 1988	N/A	
		R4	1942	66 - 1988	N/A	
		R5	1942	87 - 1988	N/A	
		R6	1942	61 - 1988	N/A	
40	PRINEVILLE AP	R1	UNK	87 - 1986	N/A	
		R2	UNK	86 - 1986	N/A	
		R3	UNK	39 - 1986	N/A	
41	PORT OF ASTORIA AP	R1	1944	87 - 1987	79 - 1991	2
		R1A	1944	77 - 1987	68 - 1991	2.25
		R2	1944	73 - 1987	99 - 1991	CHECK
42	ROBERTS FIELD/REDMOND AP	R1	1975	88 - 1986	N/A	
		R1*	1975	91 - 1986	N/A	
		R2	UNK	92 - 1986	N/A	
43	PROSPECT STATE AP	R1	1962	54 - 1987	68 - 1991	CHECK
44	ROSEBURG MUNICIPAL	R1	1951	77 - 1987	57 - 1991	5
45	SCAPPOOSE INDUSTRIAL AP	R1	1943	65 - 1987	64 - 1991	0.25
46	SEASIDE STATE AP	R1	1964	88 - 1987	83 - 1991	1.25
47	SILETZ BAY STATE AP	R1	1971	80 - 1988	N/A	
48	SPORTSMAN AIRPARK-NEWBERG	R1	1965	57 - 1986	N/A	
49	NEWPORT MUNICIPAL AP	R1	1944	91 - 1988	N/A	
		R2	1944	69 - 1988	N/A	
		R3	1944	74 - 1988	N/A	
50	SUNRIVER AP	R1	1970	92 - 1986	N/A	
51	SUTHERLIN MUNICIPAL	R1	1971	90 - 1987	N/A	

PCI LOSS DATA (OR)

No.	AIRPORT & LOCATION	ID	OCD	PCI AVG & YR	PCI AVG & YR	AVG LOSS/YR
52	THE DALLES MUNICIPAL AP	R1	1943	79 - 1988	N/A	
		R2	1943	79 - 1988	N/A	
		R3	1943	79 - 1988	N/A	
53	TILLAMOOK AP	R1	1943	92 - 1987	89 - 1991	0.75
		R2	1943	77 - 1987	100 - 1991	CHECK
54	TRI-CITY STATE AP	R1	1970	88 - 1987	77 - 1991	2.75
55	WASCO STATE AP	R1	1987	87 - 1987	N/A	

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RRD	EXISTING STRUCTURE
1	ALBANY MUNICIPAL AP	R1	1959	2"AC, 8"B	1986	2"AC OL, 2"AC, 8"B
2	ASHLAND MUNICIPAL	R1	1965	BST, 4.5"B, 3"SB	1986	2"AC OL, 1"AC, 4.5"B, 3"SB
		R2	1985	2"AC, 8"B		2"AC, 8"B
3	AURORA STATE AP	R1	1975	3"AC, 2"B, 13"SB	1978	2"AC OL, 3"AC, 2"B, 13"SB
4	BAKER MUNICIPAL AP	R2	1942	2.5"AC, 15"B	1963	2.5"AC, 15"B - SEAL
		R3	1942	2.5"AC, 15"B	1963	2.5"AC, 15"B - SEAL
		R4	1983	2.5"AC,3"B,10"PRSB	1984	2.5"AC, 3"B, 10"PRSB - FS
		R5	1983	2.5"AC, 5"B, 18"SB	1984	2.5"AC, 5"B, 18"SB - FS
5	BANDON STATE AP	R1	1966	2.5"AC, ?"B	1972	CS, 2.5"AC, ?"B
6	BEND MUNICIPAL	R1	1977	2"AC, 6"B		2"AC, 6"B
		R2	1977	2"AC, 9"B,		2"AC, 9"B
7	BOARDMAN AP	R1	1943	2"AC, 2"B, 8"SB	1980	1.5"AC, 2"AC, 2"B, 8"SB
8	BROOKINGS STATE	R1	1968	2.5"AC, 4"B		2.5"AC, 4"B
		R2	1968	1.5"AC, 4"B		1.5"AC, 4"B
9	BURNS MUNICIPAL AP	R1	1942	2"AC, 6"B, 6"SB	1978	CS, CS, 2"AC, 6"B, 6"SB
		R2	1942	2"AC, 6"B, 6"SB	1978	CS, CS, 2"AC, 6"B, 6"SB
10	CHILOQUIN STATE AP	R1	1961	1.25"AC, 4"B	1968	SC, 1.25"AC, 4"B
11	CHRISTMAS VALLEY AP	R1	1985	CS, 3"AC, 4"B, 2"SB		CS, 3"AC, 4"B, 2"SB
12	CONDON STATE AP	R1	1986	5"PCC, 2"B		5"PCC, 2"B
13	CORVALLIS MUNICIPAL AP	R1	1942	2.5"AC, 6"B, 9"SB	1984	3"AC OL, 2.5"AC, 6"B, 9"SB
		R2	1942	2"AC, 6"B, 10"SB		2"AC, 6"B, 10"SB
14	COTTAGE GROVE AP	R1	1966	1.5"AC, 7"B		1.5"AC, 7"B
		R2	1970	1.5"AC, 7"B		1.5"AC, 7"B
15	COUNTY SQUIRE AIRPARK	R1	1976	2"AC, 4-6"B		2"AC, 4-6"B
16	CRESWELL MUNICIPAL AP	R1	1987	2"AC, 4"B, 12"SB		2"AC, 4"B, 12"SB
17	FLORENCE MUNICIPAL AP	R1	1968	1.5"AC, 6"B	1985	2"AC, 6"B - REBUILD
18	GOLD BEACH MUNICIPAL	R1	1964	1"AC, 6"B	1983	1"AC, 6"B - RESURFACE
19	HERMISTON MUNICIPAL	R1	1959	1.5"AC, 3.5"B	1977	2"AC OL, 1.5"AC, 3.5"B
		R2	1977	3"AC, 6"B		3"AC, 6"B

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RPD	EXISTING STRUCTURE
20	HOOD RIVER AP	R1	1986	2"AC, 9"B		2"AC, 9"B
		R2	1986	2"AC, 13"B		2"AC, 13"B
		R3	1986	2"AC, 6"B		2"AC, 6"B
21	INDEPENDENCE STATE AP	R1	1974	2"AC, 2"B, 6"SB		2"AC, 2"B, 6"SB
22	ILLINOIS VALLEY AP	R1	1953	BST, 4"B, 6"SB	1977	2"AC OL, BST, 4"B, 6"SB
		R2	1960	3"AC, ?"B		3"AC, ?"B
23	JOHN DAY STATE AP	R1	1962	2"AC, 9"B		2"AC, 9"B
		R3	1982	2"AC, 4"B, 9"SB		2"AC, 4"B, 9"SB
24	JOSEPHINE STATE/COUNTY AP	R1	1966	1.5"AC, 5"B		1.5"AC, 5"B
25	LA GRANDE MUNICIPAL AP	R1	1942	2"AC, 4"B, 4.5"SB		2"AC, 4"B, 4.5"SB
		R2	1942	2"AC, 4"B, 4.5"SB	1974	4"AC OL, 2"AC, 4"B, 4.5"SB
		R3	1974	2"AC, 6"B, 4.5"SB		2"AC, 6"B, 4.5"SB
26	LAKE COUNTY AP	R1	1943	2"AC, 11"B, 4"SB	1985	SS,1.75"AC,2"AC,11"B,4"S
27	LEXINGTON AP	R1	1965	DBST, 4"B, 6-10"SB		DBST, 4"B, 6-10"SB AC
28	LEBANON STATE AP	R1	UNK	2"AC, 6"B	UNK	1.5"AC OL, 2"AC, 6"B
		R2	1972	2"AC, 6.5"B		2"AC, 6.5"B
29	MADRAS CITY-COUNTY AP	R1	1943	2"AC, 7.5"B, 9"SB	1977	2"AC OL, 2"AC, 7.5"B, 9"SB
		R2	1943	2"AC, 4"B, 10"SB		2"AC, 4"B, 10"SB
		R3	1943	9.5"PCC		9.5"PCC
		R4	1943	3"AC, 6"B, 10"SB		3"AC, 6"B, 10"SB
30	MCDERMITT STATE AP	R1	1985	2"AC, 3"B, 7"SB		2"AC, 3"B, 7"SB
31	MCMINNVILLE MUNICIPAL AP	R1	1943	2"AC, 6"B, 8"SB		2"AC, 6"B, 8"SB
		R2	1943	2"AC, 6"B, 10"SB	1980	SS, 2"AC, 6"B, 10"SB
32	NEWHALAM BAY STATE AP	R1	1965	BST, 6"B	1979	TBST, 6"B
33	NORTH BEND MUNICIPAL	R1	1943	3"AC, 6"B, 4.5"SB	1977	2"AC OL,CS, 3"AC,6"B,4.5"
		R2	1943	2.5"AC,5.5"B,4.75"	1977	2"ACOL,CS,2.5"AC,5.5"B,SB
		R2A	1943	2.25"AC,6.25"B,4"S	1977	2"ACOL,CS,2.25"AC,B,SB
		R3	1943	3"AC, 5.5"B, 4"SB	1952	CS, 3"AC, 5.5"B, 4"SB
34	OAKRIDGE STATE AIRPORT	R1	UNK	UNK		TBST, 1"BST, 5"CB
35	ONTARIO MUNICIPAL	R3	1978	2"AC, 6"B, 6"SB		2"AC, 6"B, 6"SB
36	OREGON CITY AIRPARK	R1	1972	1"AC, ?"B		1"AC, ?"B

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RRD	EXISTING STRUCTURE
37	PACIFIC CITY-STATE AP	R1	1950	2"AC, 4"B		2"AC, 4"B
38	PINEHURST STATE AP	R1	1956	BST, ?"B	1985	1"AC OL, BST, ?"B
39	PENDLETON MUNICIPAL	R1	1942	3"AC, 7"B, 6"SB	1974	PFC,7"ACOL,3"AC,7"B,6"SB
		R2	1942	2"AC, 8"B	1974	PFC, 7"ACOL, 2"AC, 8"B
		R3	1942	2"AC, 8"B	1978	3"AC OL, 2"AC, 8"B
		R4	1942	2"AC, 8"B	1978	5.5"AC OL, 2"AC, 8"B
		R5	1942	2"AC, 5"B	1978	10"AC OL, 2"AC, 5"B
		R6	1942	2"AC, 8"B		CS, 2"AC, 8"B
40	PRINEVILLE AP	R1	UNK	2"AC, 3"B, 3.5"SB		2"AC, 3"B, 3.5"SB
		R2	UNK	2"AC, 6"B		2"AC, 6"B
		R3	UNK	1"BST, 6"B		1"BST, 6"B
41	PORT OF ASTORIA AP	R1	1944	2.5"AC, 13"B	1980	.75"ACOL, 2.5"AC, 13"B
		R1A	1944	9"-6"-9"PCC, 9"SB	1980	.75"ACOL,9"-6"-9"PCC,9"S
		R2	1944	2.5"AC, 13"B		2.5"AC, 13"B
42	ROBERTS FIELD/REDMOND AP	R1	1975	4"AC, 7"B, 17"SB	1981	PFC, 4"AC, 7"B, 17"SB
		R1*	1975	4"AC, 7"B, 17"SB		4"AC, 7"B, 17"SB
		R2	UNK	3"AC, 2"B, 10"SB		3"AC, 2"B, 10"SB
43	PROSPECT STATE AP	R1	1962	BST, 6"B	1986	DBST, 6"B
44	ROSEBURG MUNICIPAL	R1	1951	2"AC, 6"B, 6"SB	1986	SS, 2"AC, 6"B, 6"SB
45	SCAPPOOSE INDUSTRIAL AP	R1	1943	2"AC, 6"B, 12"SB	1986	SS, 2"AC, 6"B, 12"SB
46	SEASIDE STATE AP	R1	1964	1.75"AC, 6"B		1.75"AC, 6"B
47	SILETZ BAY STATE AP	R1	1971	1.5"AC, 4.5"B, 5"SB		1.5"AC, 4.5"B, 5"SB
48	SPORTSMAN AIRPARK-NEWBERG	R1	1965	2"AC, 4"B, 10"SB		2"AC, 4"B, 10"SB
49	NEWPORT MUNICIPAL AP	R1	1944	2"AC, 6"B, 9"SB	1984	3"AC OL, 2"AC, 6"B, 9"SB
		R2	1944	2"AC, 6"B, 9"SB	1984	SS, 2"AC, 6"B, 9"SB
		R3	1944	4"AC, 6"B, 5"SB		4"AC, 6"B, 5"SB
50	SUNRIVER AP	R1	1970	DBST, 14"CB	1985	2"ACOL,SS/SC,DBST, 14"CB
51	SUTHERLIN MUNICIPAL	R1	1971	2"AC, 12"B		2"AC, 12"B
52	THE DALLES MUNICIPAL AP	R1	1943	2.25"AC, 6.75"B	1965	SS, 2.25"AC, 6.75"B
		R2	1943	2.25"AC, 6.75"B		2.25"AC, 6.75"B
		R3	1943	2.25"AC, 6.75"B		2.25"AC, 6.75"B

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RRD	EXISTING STRUCTURE
53	TILLAMOOK AP	R1	1943	2"AC, 6"B, 10"SB	1983	1.5"ACOL, 2"AC,6"B, 10"SB
		R2	1943	2"AC, 6"B, 10"SB	1983	CS, 2"AC, 6"B, 10"SB
54	TRI-CITY STATE AP	R1	1970	1.5"AC, 6"B	UNK	CS,1.5"AC, 6"B
55	WASCO STATE AP	R1	1987	1"TBST, 4"B, 6"SB		1"TBST, 4"B, 6"SB

TILLAMOOK AIRPORT, OREGON

PAVEMENT FEATURES
&
PAVEMENT CONDITION SURVEY

SEPTEMBER 9, 1991

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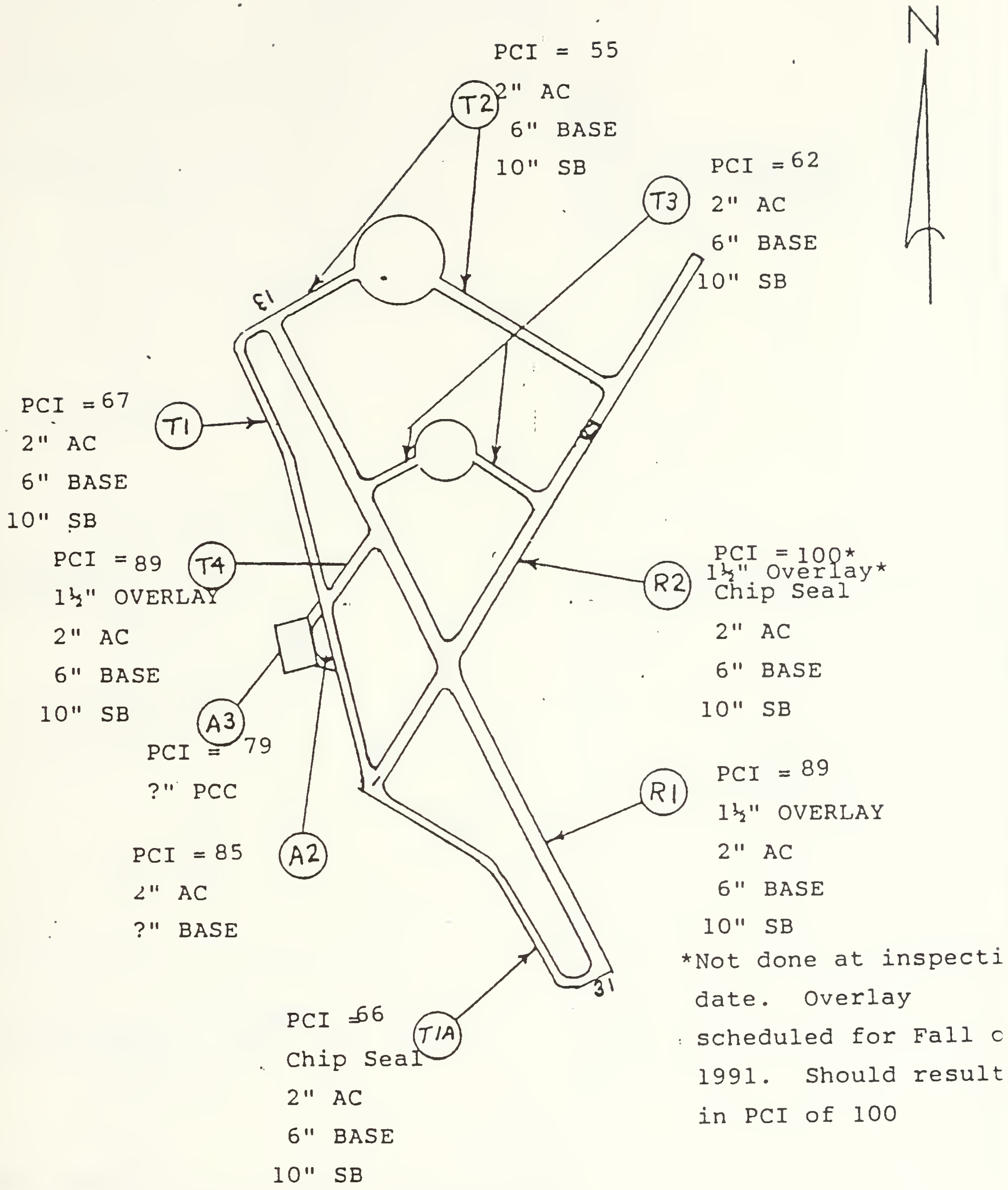


PCI = 55
2" AC
6" BASE
10" SB

PCI = 62
2" AC
6" BASE
10" SB

PCI = 67
2" AC
6" BASE
10" SB

PCI = 89
1½" OVERLAY
2" AC
6" BASE
10" SB

PCI = 100*
1½" Overlay*
Chip Seal
2" AC
6" BASE
10" SB

PCI = 79
?" PCC

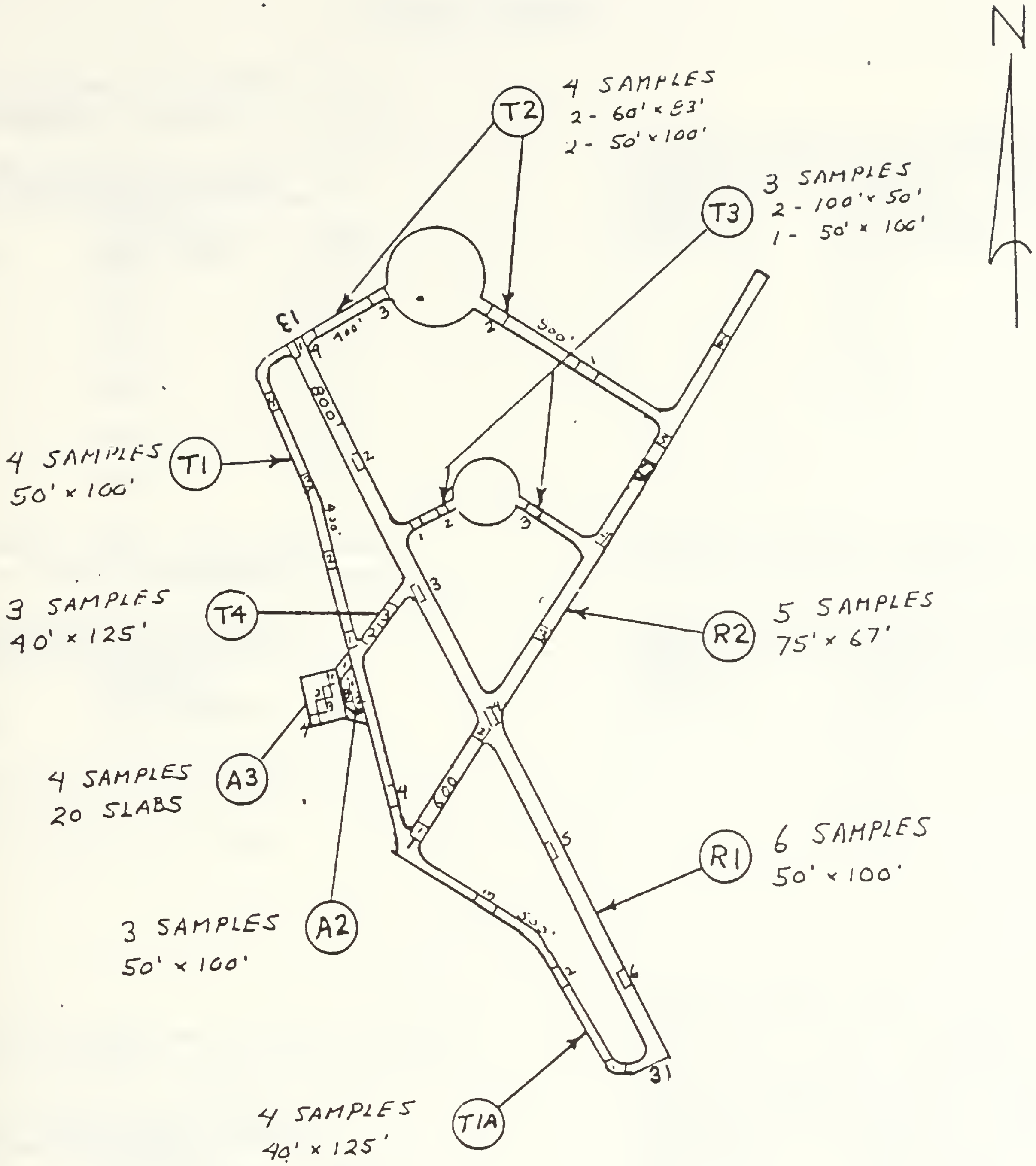
PCI = 89
1½" OVERLAY
2" AC
6" BASE
10" SB

PCI = 85
2" AC
?" BASE

PCI = 66
Chip Seal
2" AC
6" BASE
10" SB

*Not done at inspecti
date. Overlay
scheduled for Fall c
1991. Should result
in PCI of 100

TILLAMOOK AIRPORT
PAVEMENT FEATURES AND PCI NUMBERS
SEPTEMBER 9, 1991



TILLAMOOK AIRPORT
LOCATION OF SAMPLE AREAS WITHIN EACH FEATURE
SEPTEMBER 9, 1991

FEATURE SUMMARY

AIRPORT: Tillamook Airport
DATE OF SURVEY: September 9, 1991

AIRPORT FACILITY: Runway R-1, 13-31
TOTAL NO. OF SAMPLE UNITS: 6

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI
1	5000	88
2	5000	90
3	5000	91
4	5000	87
5	5000	90
6	4000	85

Average PCI: 89
Condition Rating: Excellent

AIROPRT FACILITY: Runway R-2, 1-19
TOTAL NO. OF SAMPLE UNITS:

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI

Not done as overlay shceduled for October 1991. Should relult in PCI of 100 this Fall.

Average PCI:
Condition Rating:

AIRPORT FACILITY: Taxiway T-1
TOTAL NO. OF SAMPLE UNITS: 4

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI
1	5000	67
2	5000	74
3	5000	71
4	5000	56

Average PCI: 67
Condition Rating: Good

AIRPORT FACILITY: Taxiway T-1A
TOTAL NO. OF SAMPLE UNITS:

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PC
1	5000	57
2	5000	67
3	5000	67
4	5000	74

Average PCI: 66
Condition Rating: Good

AIRPORT FACILITY: Taxiway T-2
TOTAL NO. OF SAMPLE UNITS: 4

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PC
1	5000	64
2	5000	53
3	5000	49
4	5000	54

Average PCI: 55
Condition Rating: Good

AIRPORT FACILITY: Taxiway T-3
TOTAL NO. OF SAMPLE UNITS: 3

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PC
1	5000	65
2	5000	63
3	5000	57

Average PCI: 62
Condition Rating: Good

FEATURE SUMMARY

AIRPORT: Tillamook Airport
DATE OF SURVEY: September 9, 1991

AIRPORT FACILITY: Taxiway T-4
TOTAL NO. OF SAMPLE UNITS: 3

SAMPLE UNIT NO.	**SAMPLE UNIT AREA**	**PCI**
1	5000	85
2	5000	91
3	5000	91

Average PCI: 89
Condition Rating: Excellent

AIROPRT FACILITY: Apron A-2
TOTAL NO. OF SAMPLE UNITS: 3

SAMPLE UNIT NO.	**SAMPLE UNIT AREA**	**PCI**
1	5000	88
2	5000	84
3	5000	82

Average PCI: 85
Condition Rating: Excellent

AIRPORT FACILITY: Apron A-3
TOTAL NO. OF SAMPLE UNITS: 4

SAMPLE UNIT NO.	**SAMPLE UNIT AREA**	**PCI**
1	20 slabs	74
2	" "	84
3	" "	82
4	" "	77

Average PCI: 79
Condition Rating: Very Good

PRINCIPAL DISTRESSES:

RUNWAY R-1	Raveling/weathering
RUNWAY R-2	Raveling, depressions and cracking
TAXIWAY T-1	Block, longitudinal & transverse cracking , depressions & raveling
TAXIWAY T-1A	Raveling, depressions and cracking
TAXIWAY T-2	Block cracking, depressions and raveling/weathering
TAXIWAY T-3	Longitudinal & transverse cracking, depressions & raveling/weathering
TAXIWAY T-4	Raveling/weathering
APRON A-2	Raveling/weathering and oil spillage
APRON A-3	Joint seal damage

TILLAMOOK AIRPORT
PAVEMENT DEVELOPMENT AND MAINTENANCE

SEPTEMBER 9, 1991

The original construction of 1942-43 was a combination of DLAND-USED and Navy. Except for a small concrete apron of unknown thickness, on the west side, all pavements were flexible construction consisting of 2" AC, 6" Base and 10" Subbase. On taxiways and aprons the surface thickness was 2½". It appears nothing was done to the pavement, except for a possible slurry seal on a few sections, until 1983. At that time a Federally funded project assisted in overlay of Runway 13-31, and chip seal on 1-19 and the southern portion of the taxiway parallel to 13-31. Also, at that time the short taxiway from the concrete apron to runway 13-31 was overlaid. The island between the concrete apron and parallel taxiway was surfaced about the same time.

Traffic at this airport has consisted mainly of light single and twin engine aircraft but occasionally a large aircraft will visit the airport.

Currently, runway 13-31 continues to be in excellent condition. But, it does show a significant tendency to ravel with many fine particles coming loose. A fog seal might help this. Runway 1-19 has a lot of loose stone and is scheduled for a 1½" minimum overlay in Fall of this year. That should result in an excellent condition and a PCI rating of 100.

The aprons are in very good condition but the concrete apron could use new joint seal as it has had nothing done to it in 48 years. The bituminous portion of apron shows a significant tendency to ravel and a fog seal might help here also. All of the other pavements are original, although the north portion of the parallel taxiway looks like it had a slurry seal once, and are in good condition. Typically they have some depressions, fine cracking and raveling/weathering. Some have a lot of vegetation in the cracks.

The ideal solution on these pavements would be an overlay as was accomplished on runway 13-31. The active taxiways could be overlaid 35' wide or maybe 40'. This treatment would correct all problems including depressions. But, if funds are insufficient, removing vegetation and slurry sealing these pavements would be a big improvement. Even though the southern portion of the parallel taxiway received a chip seal, an overlay of the entire taxiway at 35' or 40' would be desirable. A short portion of taxiway T-2 from runway end 13 to the T hangar area is scheduled for a slurry seal in Fall of 1991. The remaining longer section of T-2 would seem to be an ideal cnadidate for a slurry seal.

SUGGESTED PAVEMENT PROGRAM IS AS FOLLOWS:
Overlay parallel taxiway to runway 13-31 approx. 5500' x 35'
21,389 S. Y. @ $7.00 = $150,000.00
Fog seal runway 13-31
55,555 S. Y. @ $0.20 = $ 11,000.00
Remove vegetation and slurry seal taxiways between runways to 40' width
15,000 S. Y. @ $2.00 = $ 30,000.00
Replace joint seal in concrete apron = $ 9,000.00

PAVEMENT CONDITION TREND

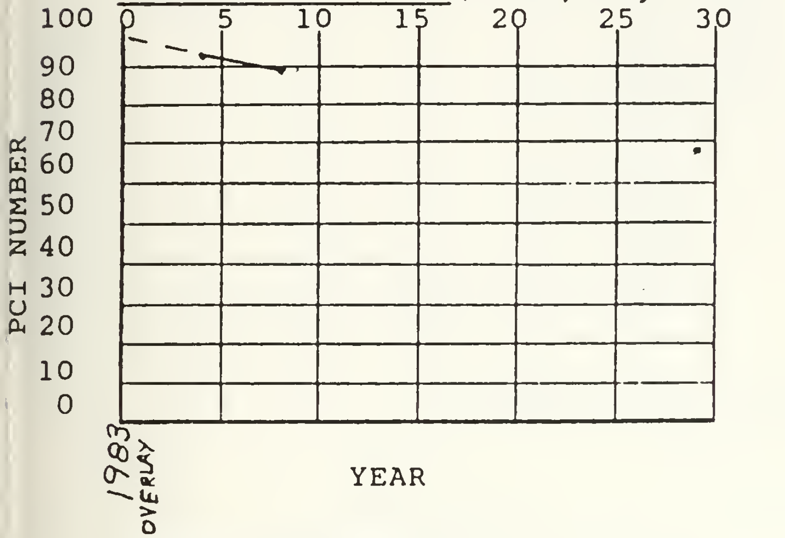
AIRPORT: Tillamook

DATE OF LAST SURVEY: Sept. 9, 1991

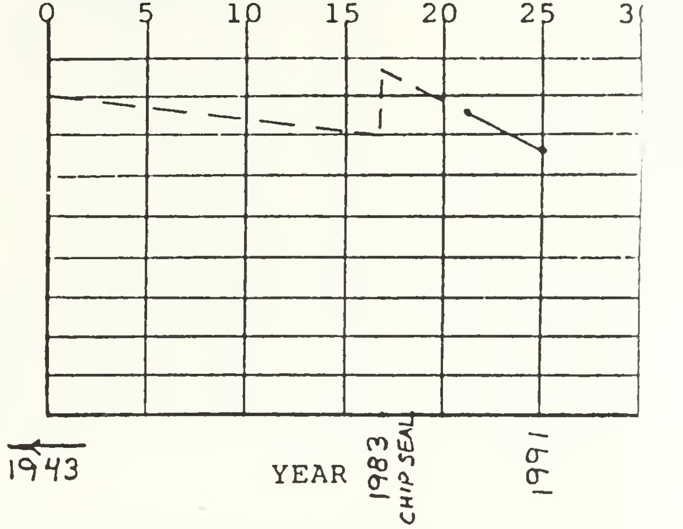
NOTES: PCI NUMBER indicates

PAVEMENT CONDITION INDEX
Horizontal scale covers 30 yrs.
Year 0 is year of original
construction, major reconstruct
or overlay

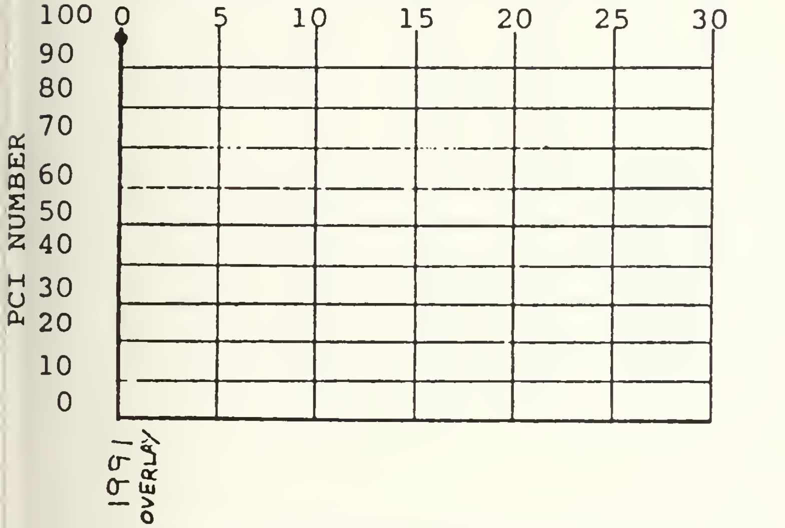
AIRPORT FACILITY: Runway R1, 15-33



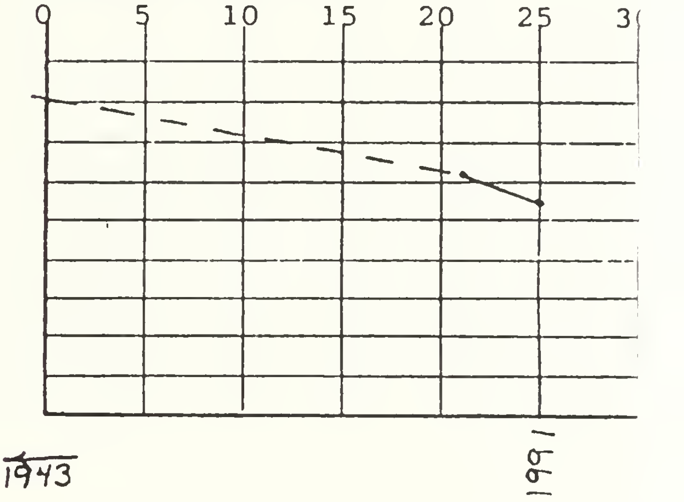
AIRPORT FACILITY: Taxiway T1A



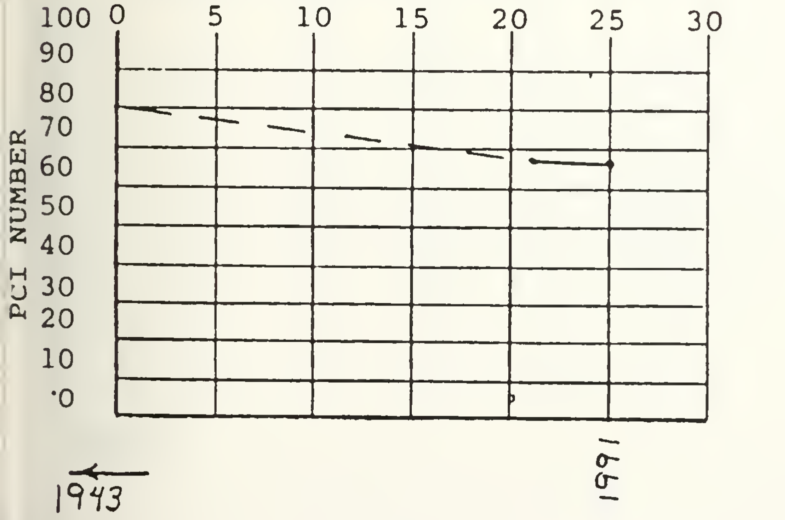
AIRPORT FACILITY: Runway R2, 1-19



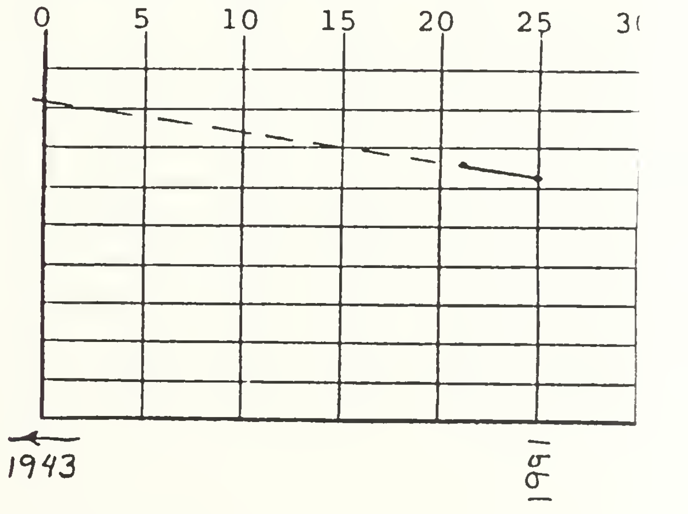
AIRPORT FACILITY: Taxiway T2



AIRPORT FACILITY: Taxiway T1



AIRPORT FACILITY: Taxiway T3



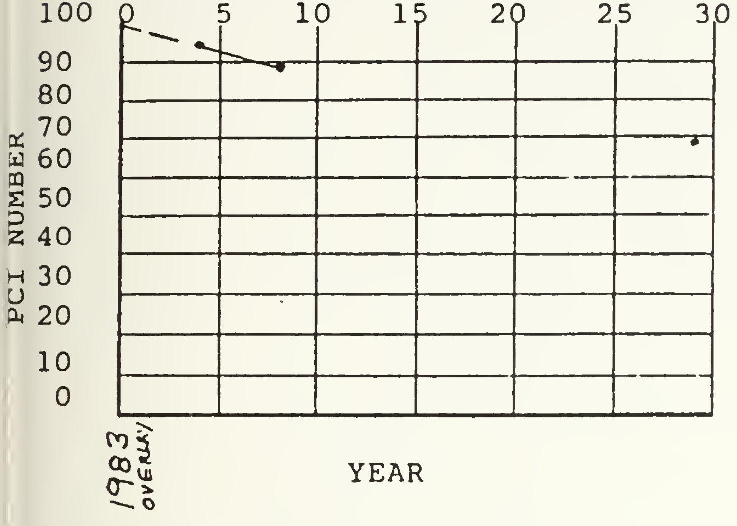
PAVEMENT CONDITION TREND

AIRPORT: Tillamook

DATE OF LAST SURVEY: Sept. 9, 1991

NOTES: PCI NUMBER indicates
PAVEMENT CONDITION INDEX
Horizontal scale covers 30 yrs.
Year 0 is year of original
construction, major reconstruct
or overlay

AIRPORT FACILITY: Taxiway T4

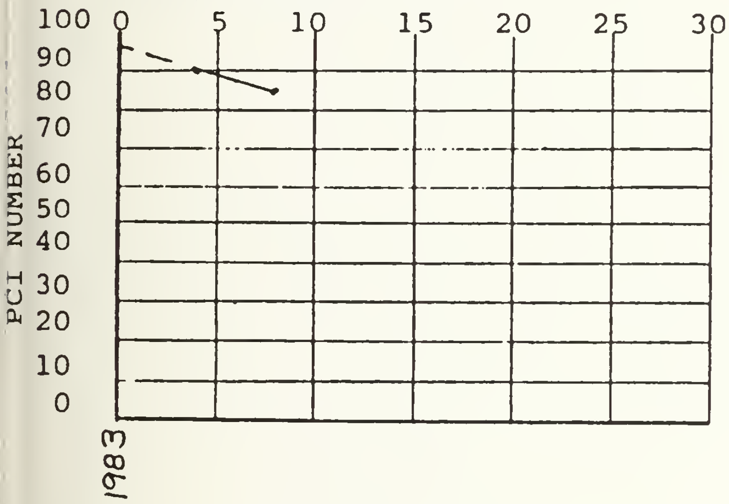


YEAR

AIRPORT FACILITY:

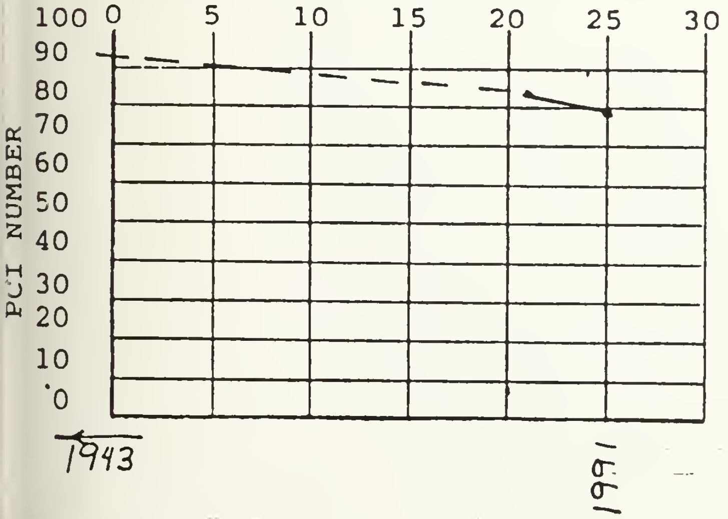
YEAR

AIRPORT FACILITY: Apron A2



AIRPORT FACILITY:

AIRPORT FACILITY: Apron A3



AIRPORT FACILITY:

APPENDIX C

GUIDELINES AND PROCEDURES FOR MAINTENANCE OF AIRPORT PAVEMENTS

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

ADVISORY CIRCULAR
AC: 150/5380-6
DATE: 12/3/82

U.S. Department
of Transportation

**Federal Aviation
Administration**

Guidelines and Procedures for Maintenance of Airport Pavements

AC: 150/5380-6
Date: 12/3/82

Advisory Circular

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: GUIDELINES AND PROCEDURES FOR MAINTENANCE OF AIRPORT PAVEMENTS

Date: 12/3/82
Initiated by: AAS-200

AC No: 150/5380-6
Change:

1. PURPOSE. This advisory circular (AC) provides guidelines and procedures for maintenance of rigid and flexible airport pavements.

2. FOCUS.

a. Poor maintenance of airport pavements is the result of a variety of causes, among which are lack of funds, untrained personnel, and lack of adequate information. This AC provides specific guidelines and procedures for maintaining airport pavements and establishing an effective maintenance program. Specific types of distress, their probable causes, inspection guidelines, and recommended methods of repair are discussed.

b. This information has been developed to assist airport managers, engineers, and maintenance personnel responsible for pavement design, performance, maintenance, and repair. It is intended primarily for use at small- and medium-size airports that may lack the technical support of an adequate well-trained engineering/maintenance staff or the financial resources to retain a pavement consultant.

3. RELATED READING MATERIAL. The publications listed in Appendix C, Bibliography, provide further guidance and technical information.

APPENDIX A: CONDITION SURVEY PROCEDURE

GENERAL

This appendix gives the detailed procedure for performing a pavement condition survey at civil airports. The procedure is presently limited to flexible pavements (all pavements with conventional bituminous concrete surfaces) and jointed rigid pavements (jointed nonreinforced concrete pavements with joint spacing not exceeding 25 ft). Specific objectives for the condition survey are:

a. To determine present condition of the pavement in terms of apparent structural integrity and operational surface condition.

b. To provide FAA with a common index for comparing the condition and performance of pavements at all airports and also provide a rational basis for justification of pavement rehabilitation projects.

c. To provide feedback on pavement performance for validation and improvement of current pavement design, evaluation, and maintenance procedures.

The airport pavement condition survey and the determination of the PCI are the primary means of obtaining and recording vital airport pavement performance data. The condition survey for both rigid and flexible pavement facilities consists principally of a visual inspection of the pavement surfaces for signs of pavement distress resulting from the influence of aircraft traffic and environment.

BASIC AIRPORT INFORMATION

A considerable amount of basic airport data is incorporated into the condition survey report. Most of this information is contained in construction and maintenance records and in previous condition survey reports. To facilitate report preparation, the basic data should be accumulated and maintained by the airport engineer. The following items should be compiled for subsequent use during the condition survey:

a. Design/construction/maintenance history. The history of maintenance, repair, and reconstruction from original construction of the airport pavement system to the present should be maintained. These data should reflect airport paving projects

and airport change projects accomplished either in-house or by a contractor.

b. Traffic history. Air carrier, commuter, cargo, and military aircraft traffic records, including aircraft type, typical gross loads, and frequency of operation.

c. Climatological data. Annual temperature ranges and precipitation data should be obtained from the weather office nearest the airport.

d. Airport layout. Plans and cross sections of all major airport components, including subsurface drainage systems. These should be updated to reflect new construction upon completion of the project.

e. Frost action. If applicable, records of pavement behavior during freezing periods and subsequent thaws should be recorded.

f. Photographs. Photographs depicting both general and specific airport conditions should be taken.

g. Pavement condition survey reports. All previous pavement condition survey reports should be maintained to be referenced in the current report.

A series of data summary sheets has been devised and is presented in Figures A-1 through A-4. These summary sheets should be helpful to the personnel involved in obtaining and maintaining the necessary information. Narrative information pertaining to unusual problems, solutions, or attempted solutions to these problems should be included. This information would be beneficial in determining research needs as well as in providing a means of distributing information.

OUTLINE OF BASIC CONDITION RATING PROCEDURE

The steps for performing the condition survey and determining the PCI are described below and in Figure A-5:

a. Station or mark off the airport pavements in 100-ft increments. This is done semipermanently to assure ease of proper positioning for the condition survey. The overall airport pavements must first be divided into features based on the pavements design, construction history, and traffic area. A designated pavement feature, therefore, has consistent structural thickness and materials, was constructed at the same time, and is located in one airport facility, i.e., runway, taxiway, etc. After initially designating the features on the airport, make a preliminary survey. This survey shall entail a brief but complete visual survey of all the airport pavements. By

observing distress in an individual feature, it may be determined whether there are varying degrees of distress in different areas. In such cases, the feature should be subdivided into two or more features.

b. The pavement feature is divided into sample units. A sample unit for jointed rigid pavement is approximately 20 slabs; a sample unit for flexible pavement is an area of approximately 5000 sq ft.

c. The sample units are inspected, and distress types and their severity levels and densities are recorded. Appendix B provides a comprehensive guide for identification of the different distress types and their severity levels. The criteria in Appendix B must be used in identifying and recording the distress types and severity levels in order to obtain an accurate PCI.

d. For each distress type, density, and severity level within a sample unit, a deduct value is determined from the appropriate curve.

e. The total deduct value (TDV) for each sample unit is determined by adding all deduct values for each distress condition observed.

f. A corrected deduct value (CDV) is determined using procedures in the appropriate section for jointed rigid or flexible pavements.

g. The PCI for each sample unit inspected is calculated as follows:

$$PCI = 100 - CDV$$

If the CDV for a sample unit is less than the highest individual distress deduct value, the highest value should be used in lieu of the CDV in the above equation.

h. The PCI of the entire feature is the average of the PCI's from all sample units inspected.

i. The feature's pavement condition rating is determined from a figure that presents verbal descriptions of a pavement condition as a function of PCI value.

SAMPLING TECHNIQUES

Inspection of an entire feature may require considerable effort, especially if the feature is very large. This may be particularly true for flexible pavements containing much distress. Because of the time and effort involved, frequent surveys of the entire feature may be

beyond available manpower, funds, and time. A sampling plan has, therefore, been developed so that an adequate estimate of the PCI can be determined by inspecting a portion of the sample units within a feature. Use of the statistical sampling plan described here will considerably reduce the time required to inspect a feature without significant loss of accuracy. However, this statistical sampling plan is optional, and inspection of the entire feature may be desirable. The airport engineer should specify whether statistical sampling may be used. The condition survey proceeds as follows:

a. Determination of pavement feature. The first step in the condition survey is the designation of pavement features. Each facility such as a runway, taxiway, etc., is divided into segments or features that are definable in terms of (1) the same design, (2) the same construction history, (3) the same traffic area, and (4) generally the same overall condition. General features can be determined from pavement design and construction records and can be further subdivided as deemed necessary based on a preliminary survey. It is important that all pavement in a given feature be such that it can be considered uniform. As an example, the center part of some runways in the traffic lanes should be separate features from the shoulder portion outside the traffic lanes.

b. Selection of sample units to be inspected. The minimum number of sample units that must be surveyed to obtain an adequate estimate of the PCI of a feature is selected from Figure A-6. Once the number of sample units η has been determined from Figure A-6, the spacing interval of the units is computed from

$$i = \frac{N}{\eta}$$

where

i = spacing interval of units to be sampled
N = total number of sample units in the feature
η = number of sample units to be inspected

All the sample numbers within a feature are numbered and those that are multiples of the interval i are selected for inspection. The first sample unit to be inspected should be selected at random between 1 and i. Sample unit size should be 5000 sq ft (generally 50 by 100 ft) for flexible pavement and 20 adjacent slabs for rigid pavement. Figures A-7 and A-8 illustrate the division of a jointed rigid pavement and flexible pavement feature, respectively, into sample units.

Each sample unit is numbered so it can be relocated for future inspections, maintenance needs, or statistical sample purposes. Each of the selected sample units must be inspected and its PCI determined. The mean PCI of a pavement feature is determined by averaging the PCI of each sample unit inspected within the feature. When it is desirable to inspect a sample unit that is in addition to those selected by the above procedure, then one or more additional sample units may be inspected and the mean PCI of the feature computed from:

$$PCI_f = \frac{(N - A)}{N} \overline{PCI_1} + \frac{A}{N} \overline{PCI_2}$$

where

PCI_f = mean PCI of feature

N = total number of sample units in feature

A = number of additional sample units

$\overline{PCI_1}$ = mean of PCI for n number of statistically selected units

$\overline{PCI_2}$ = mean PCI for all additional sample units

It is necessary that each sample unit be identified adequately so that it can be relocated for additional inspections to verify distress data or for comparison with future inspections. Based on significant variation of sample unit PCI along a feature and/or significant variation in distress types among sample units, one feature should be divided into two or more features for future inspections and maintenance purposes.

DETAIL SURVEY PROCEDURE FOR RIGID PAVEMENT

Each sample unit, or those selected by the statistical sampling procedure, in the feature is inspected. The actual inspection is performed by walking over each slab of the sample unit being surveyed and recording distress existing in the slab on the jointed rigid pavement survey data sheet (Figure A-9). One data sheet is used for each sample unit. A sketch is made of the sample unit, using the dots as joint intersections. The appropriate number code for each distress found in the slab is placed in the square representing the slab. The letters L (low), M (medium), or H (high) are included along with the distress number code to indicate the severity level of the distress. For example, 15L indicates that low severity corner spalling exists in the slab.

Refer to Appendix B for aid in identification of distresses and their severity levels. Follow these guidelines very closely.

Space is provided on the jointed rigid pavement survey data sheet for summarizing the distresses and computing the PCI for the sample unit. Summarize the distress type numbers and their severity levels and the number of slabs in the sample unit containing each type and level. Calculate the percentage of the total number of slabs in the sample unit containing each distress type and severity level. Using Figures A-10 through A-24, determine the deduct value for each distress type and severity level. Sum the deduct values to obtain the deduct total.

Noting how many individual deduct values are greater than 5, consult Figure A-25 to obtain the CDV. The PCI is then calculated and the rating (from Figure A-26) is entered on the jointed rigid pavement survey data sheet (Figure A-9). If the CDV for a sample unit is less than the highest individual distress deduct value, the highest value should be used in determining the PCI.

The PCI's for all sample units are compiled into a feature summary, as shown in Figure A-27. The overall condition rating of the feature is determined by using the mean PCI and Figure A-26.

DETAILED PROCEDURE FOR FLEXIBLE PAVEMENT

Each sample unit, or those selected by the sampling procedure, in the feature is inspected. The distress inspection is conducted by walking over the sample unit, measuring the distress type and severity according to Appendix B, and recording the data on the flexible pavement survey data sheet (Figure A-28). One data sheet is used for each sample unit. A hand odometer is very helpful for measuring distress. A 10-ft straightedge and a 12-in. scale must be available for measuring the depths of ruts or depressions. Each column on the data sheet is used to represent a distress type, and the amount and severity of each distress located are listed in the column. For example, distress No. 5 (depression) is recorded as 6 × 4L, which indicates that the depression is 6 by 4 ft and of low severity. Distress type No. 8 (longitudinal and

transverse cracking) is measured in linear feet, thus 10L indicates 10 ft of light cracking. This format is very convenient for recording data in the field.

Each distress type and severity level are summed either in square feet or linear feet, depending on the type of distress. The total units, either in square feet or linear feet, for each distress type and severity level are divided by the area of the sample unit to obtain the percent density. Using Figures A-29 through A-44, determine the deduct value for each distress type and severity level. Sum the deduct values to obtain the deduct total.

Noting how many individual deduct values are greater than 5, use Figure A-45 to obtain the CDV. The PCI is then calculated, and the rating (from Figure A-26) is entered on the flexible pavement survey data sheet. If the CDV for a sample unit is less than the highest individual distress deduct value, the highest value should be used in determining the PCI.

The PCI's for each sample unit are compiled into a feature summary, as shown in Figure A-46. The mean PCI for the feature is determined by averaging the PCI's from each sample unit. The overall condition rating of the feature is determined by use of the mean PCI and Figure A-26.

REPORTING CONDITION SURVEY RESULTS

The format for reporting the findings of the airport condition survey may be informal, designed to preclude the necessity of extensive drafting and typing. The pavement distress data and PCI computations can be presented as directly obtained from the survey data sheets and computations. The basic airport data collected will primarily reflect changes in airport pavement systems that have occurred since the last condition survey report. Reports should be prepared by the airport engineer on a recurring cycle at intervals designed to reflect gradual changes in pavement surface conditions. Reports should include, but not be limited to, the following:

a. Design pavement structure data. A form, such as Figure A-1, to include the history of all airport pavements, from original construction to the most recent changes and additions.

b. Pavement structural evaluation summary. If available, a summary of the last structural evaluation data (see Figure A-2).

c. Pavement maintenance record. When, where, and what type of maintenance has been performed (see Figure A-3).

d. Aircraft traffic data survey. Types of aircraft, typical gross loads, and airport facilities most likely used by the aircraft; also, the frequency of operations (see Figure A-4).

e. Plans and cross sections.

    (1) Airport layout plan. The airport layout plan should depict airport pavements existing at the time of the condition survey. All airport facilities should be delineated and identified.

    (2) Condition rating. An airport layout plan keyed to indicate the narrative condition rating of each feature. The feature PCI's should be indicated, possibly in tabular form.

    (3) Drainage. Existing problem areas should be identified. Surface and subsurface drainage should be shown in plan and profile for all areas near to and intersecting with airport pavements.

f. Narrative. A narrative consisting of a written account of the visual condition of each feature. The purposes of the narrative are:

    (1) To briefly describe the general condition of the pavement facilities.

    (2) To describe operational conditions and problems.

    (3) To describe the condition of other airport facilities found near the load-bearing pavements such as runway shoulders and overrun areas.

g. Photographs. Photographs showing typical or specific pavement conditions. An aerial photograph, current within 3 years, is desirable.

____________________ AIRPORT

PAVEMENT STRUCTURAL EVALUATION SUMMARY

FACILITY	LOCATION	DATE OF EVALUATION	TYPE OF EVALUATION	EVALUATED BY	ALLOWABLE LOAD (AIRCRAFT, LOAD, DEPARTURES)	THICKNESS AND TYPE OF OVERLAY RECOMMENDED

Figure A-2. Pavement structural evaluation summary

_______________ AIRPORT

TRAFFIC DATA SURVEY REVISED: __________

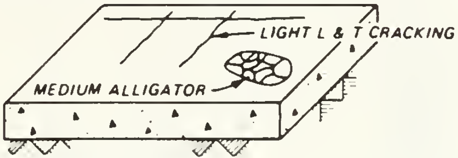
TYPE OF OPERATION	AIRCRAFT OPERATOR	TYPE AIRCRAFT	FACILITY MOST FREQUENTLY USED			TYPICAL GROSS WEIGHT	DEPARTURES PER DAY
			RUNWAY	TAXIWAY	APRON		
AIR CARRIER							
COMMUTER							
CARGO							
MILITARY							

Figure A-4. Traffic data survey

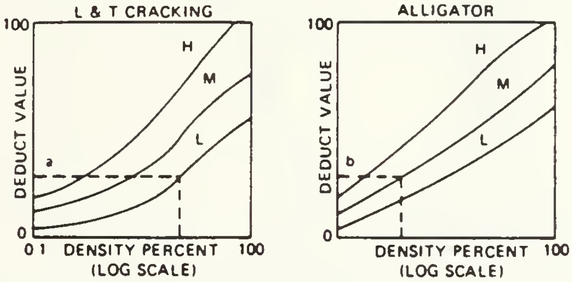
STEP 1. DIVIDE PAVEMENTS INTO FEATURES.

STEP 2. DIVIDE PAVEMENT FEATURE INTO SAMPLE UNITS.

STEP 3. INSPECT SAMPLE UNITS; DETERMINE DISTRESS TYPES AND SEVERITY LEVELS AND MEASURE DENSITY.

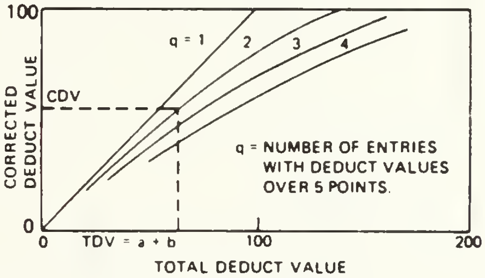


STEP 4. DETERMINE DEDUCT VALUES



STEP 5. COMPUTE TOTAL DEDUCT VALUE (TDV) a + b

STEP 6. ADJUST TOTAL DEDUCT VALUE



STEP 7. COMPUTE PAVEMENT CONDITION INDEX (PCI) = 100 - CDV FOR EACH SAMPLE UNIT INSPECTED.

STEP 8. COMPUTE PCI OF ENTIRE FEATURE (AVERAGE PCI'S OF SAMPLE UNITS).

STEP 9. DETERMINE PAVEMENT CONDITION RATING OF FEATURE.

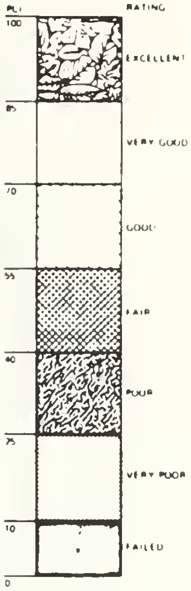


Figure A-5. Steps for determining PCI of a pavement feature

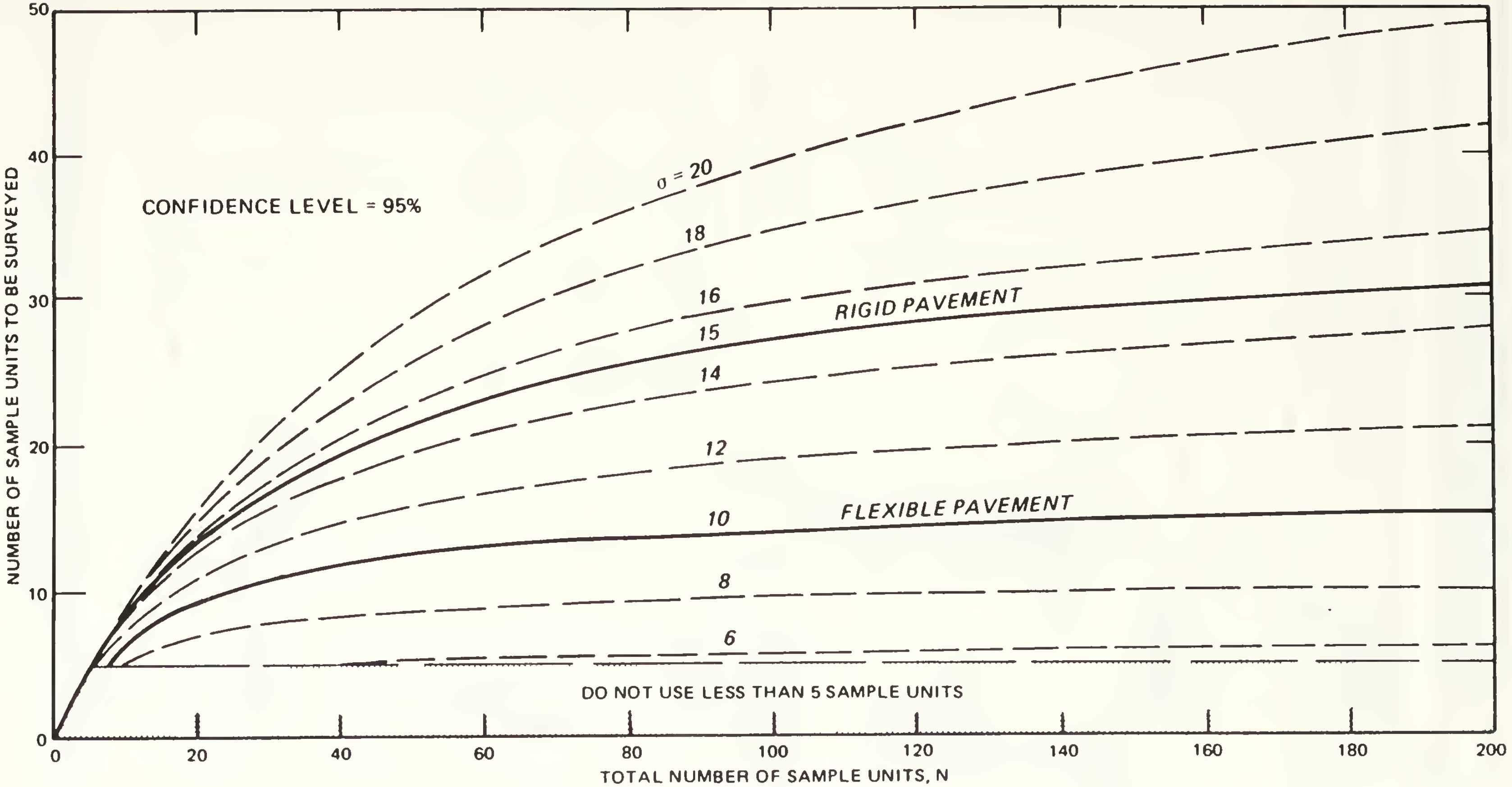
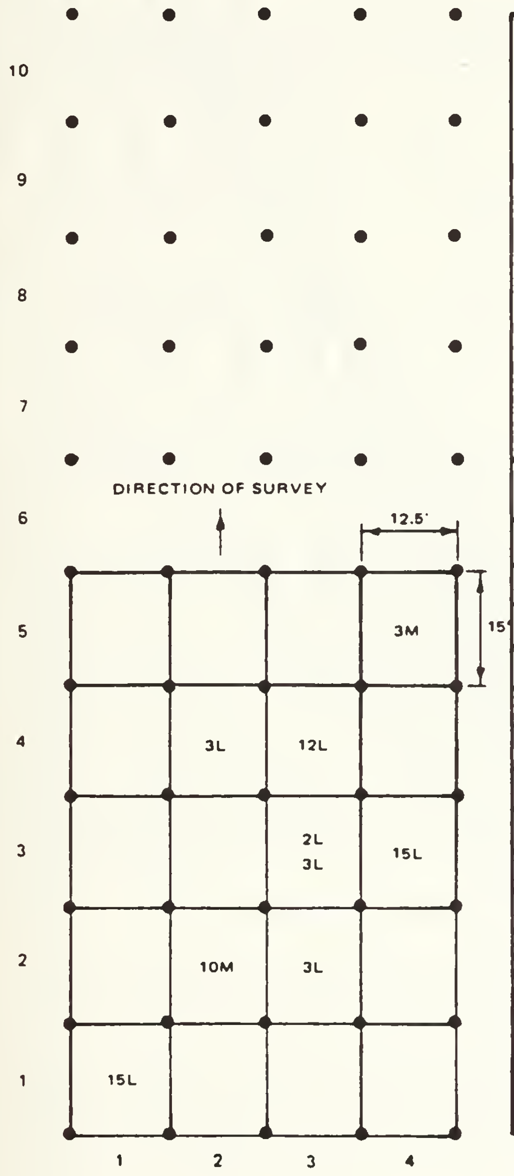


Figure A-6. Selection of minimum number of sample units

JOINTED RIGID PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT WORLD INTERNATIONAL	DATE 5/26/79

FACILITY RWY 9-27	FEATURE R3	SAMPLE UNIT 12
SURVEYED BY JH/DE		SLAB SIZE 12.5 X 15 FT



DISTRESS TYPES

1. BLOW-UP
2. CORNER BREAK
3. LONGITUDINAL/ TRANSVERSE/ DIAGONAL CRACK
4. "D" CRACK
5. JOINT SEAL DAMAGE
6. PATCHING, <5 FT^2
7. PATCHING/ UTILITY CUT
8. POPOUTS
9. PUMPING
10. SCALING/MAP CRACK/CRAZING
11. SETTLEMENT/ FAULT
12. SHATTERED SLAB
13. SHRINKAGE CRACK
14. SPALLING -- JOINTS
15. SPALLING -- CORNER

DIST. TYPE	SEV.	NO. SLABS	DENSITY %	DEDUCT VALUE
2	L	1	5	4
3	L	3	15	11
3	M	1	5	11
10	M	1	5	7
12	L	1	5	10
15	L	2	10	3

DEDUCT TOTAL	46
CORRECTED DEDUCT VALUE (CDV)	32

PCI = 100 – CDV = 68

RATING = GOOD

Figure A-9. Jointed rigid pavements - condition survey data sheet

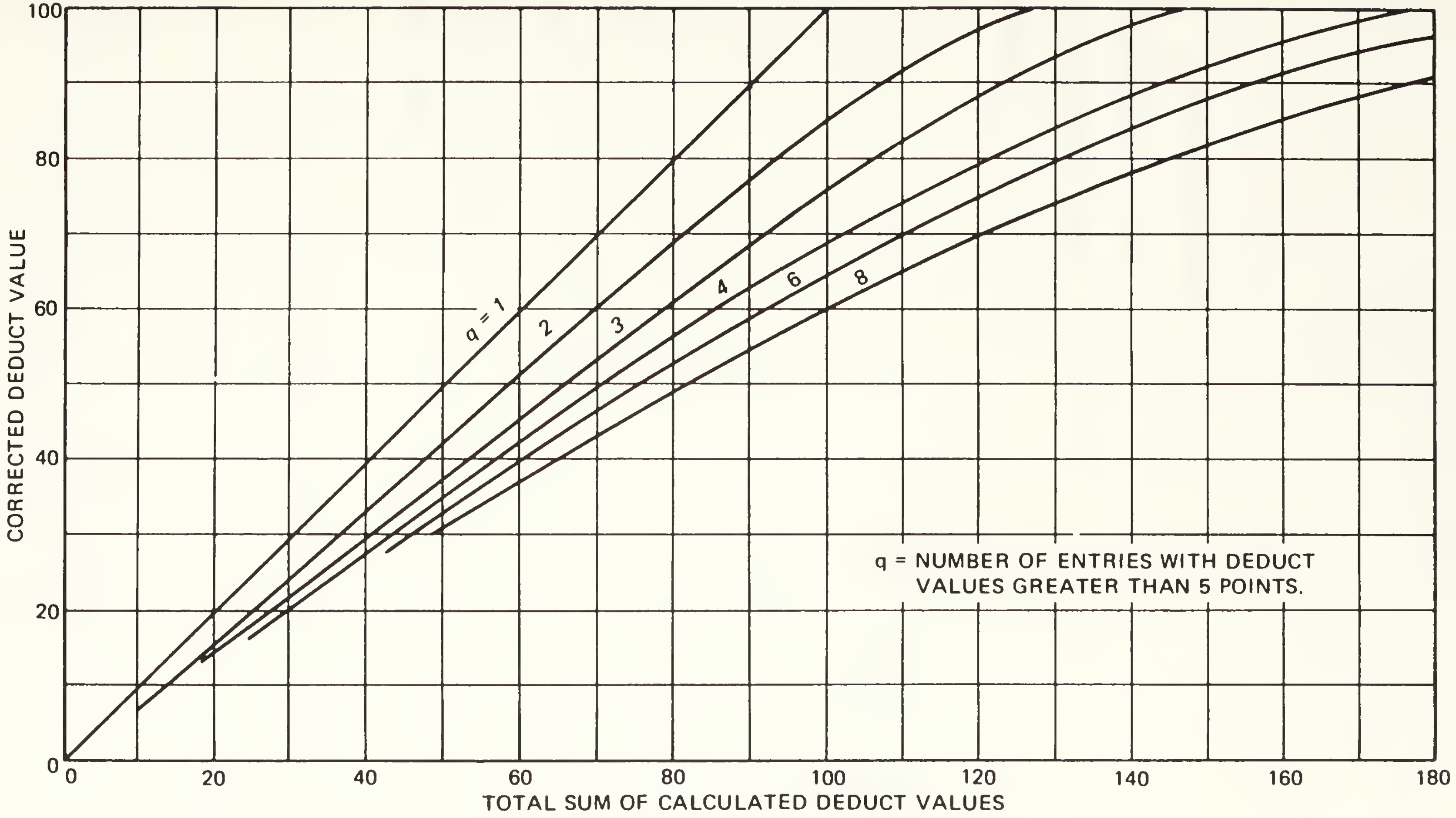


Figure A-25. Corrected deduct values for jointed rigid pavements

Airport: World International

Airport Facility: Taxiway 1

Total No. of Sample Units: 5

Date of Survey: 15 March 1979

Sample Unit No.	No. of Slabs	Slab Size	PCI
1	20	12.5 x 15	68
2	20	12.5 x 15	64
3	20	12.5 x 15	64
4	20	12.5 x 15	74
5	20	12.5 x 15	28

Sample Unit No.	No. of Slabs	Slab Size	PCI

Average PCI for Feature: 62

Condition Rating: Good

Figure A-27. Feature summary - jointed rigid pavement

FLEXIBLE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT WORLD INTERNATIONAL	DATE 5/26/79

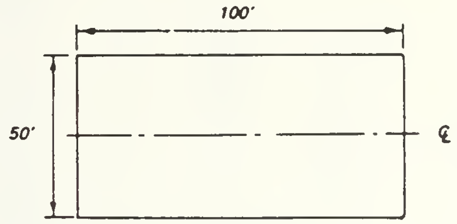
FACILITY TXY E	FEATURE T-11	SAMPLE UNIT 4

SURVEYED BY JH/DE	AREA OF SAMPLE 5000 SQ FT

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH



EXISTING DISTRESS TYPES

		1	5	8	12		
		4 X 4 M	6 X 4 L	10 L	3 X 10 M		
		2 X 3 L		5 L			
				15 L			
				5 M			
				10 L			
				5 M			
TOTAL SEVERITY	L	6 SQ FT	24 SQ FT	40 FT			
	M	16 SQ FT		10 FT	30 SQ FT		
	H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
1	L	0.22	7
1	M	0.32	19
5	L	0.48	2
8	L	0.80	5
B	M	0.20	5
12	M	0.60	7
DEDUCT TOTAL			45
CORRECTED DEDUCT VALUE (CDV)			25

PCI = 100 – CDV = 75

RATING = VERY GOOD

Figure A-28. Flexible pavements - condition survey data sheet

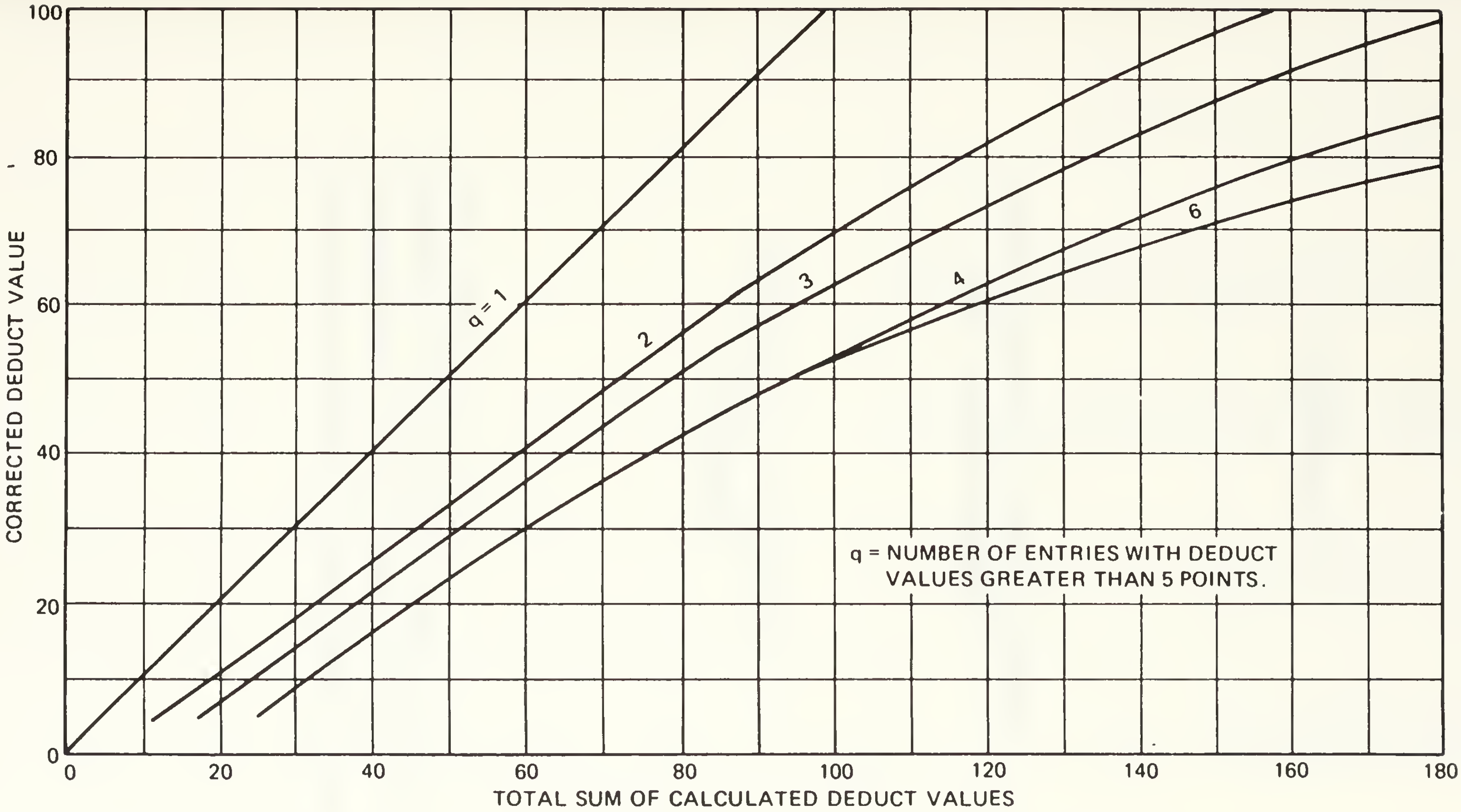


Figure A-45. Corrected deduct values for flexible pavements

APPENDIX D

MINITAB SOFTWARE CALCULATIONS AND MODELS DERIVED

INCLUDES ALL PAVEMENT CATEGORIES

1. APPLICABLE DATA POINTS
2. REGRESSION ANALYSIS OF WASHINGTON DATA
3. REGRESSION ANALYSIS OF OREGON DATA
4. COMBINED STATES DATA REGRESSION ANALYSIS

PCC AGE	PCC PCI	2-3"AC/6-8"	2-3/6-8 PCI	WWII AGE	WWII PCI	2-3/>8 AGE	2-3/>8 PCI
43.000	86.000	0.000	100.000	0.000	100.000	13.000	95.000
46.000	84.000	13.000	64.000	44.000	54.000	16.000	90.000
43.000	33.000	10.000	67.000	43.000	47.000	13.000	100.000
46.000	26.000	13.000	82.000	46.000	39.000	16.000	92.000
45.000	84.000	17.000	80.000	46.000	55.000	19.000	90.000
49.000	81.000	20.000	55.000	49.000	45.000	23.000	87.000
45.000	78.000	24.000	51.000	47.000	52.000	4.000	89.000
49.000	67.000	16.000	86.000	43.000	49.000	8.000	84.000
44.000	40.000	20.000	77.000	46.000	42.000	4.000	90.000
48.000	33.000	14.000	29.000	43.000	77.000	8.000	82.000
44.000	47.000	18.000	18.000	46.000	59.000	8.000	89.000
48.000	26.000	3.000	94.000			11.000	85.000
44.000	72.000	6.000	90.000			18.000	70.000
47.000	69.000	15.000	71.000			21.000	48.000
1.000	94.000	18.000	49.000			1.000	96.000
5.000	78.000	12.000	88.000			5.000	92.000
0.000	100.000	15.000	83.000			1.000	95.000
		2.000	92.000			5.000	90.000
		6.000	88.000			0.000	100.000
		37.000	79.000				
		41.000	75.000				
		23.000	88.000				
		27.000	83.000				
		4.000	88.000				
		8.000	77.000				

1

PLOT DATA (WA)

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PCC AGE	PCC PCI	2-3"AC/6-8"	2-3/6-8 PCI	WWII AGE	WWII PCI	2-3/>8 AGE	2-3/>8 PCI
43.000	86.000	0.000	100.000	0.000	100.000	13.000	95.000
46.000	84.000	13.000	64.000	44.000	77.000	16.000	90.000
43.000	33.000	10.000	67.000	47.000	78.000	13.000	100.000
46.000	26.000	13.000	82.000	44.000	54.000	16.000	92.000
45.000	84.000	17.000	80.000	43.000	47.000	19.000	90.000
49.000	81.000	20.000	55.000	46.000	39.000	23.000	87.000
45.000	78.000	24.000	51.000	46.000	55.000	4.000	89.000
49.000	67.000	16.000	86.000	49.000	45.000	8.000	84.000
44.000	40.000	20.000	77.000	47.000	52.000	4.000	90.000
48.000	33.000	14.000	29.000	43.000	49.000	8.000	82.000
44.000	47.000	18.000	18.000	46.000	42.000	8.000	89.000
48.000	26.000	3.000	94.000	43.000	77.000	11.000	85.000
44.000	72.000	6.000	90.000	46.000	59.000	18.000	70.000
47.000	69.000	15.000	71.000			21.000	48.000
0.000	100.000	18.000	49.000			0.000	100.000
		12.000	88.000				
		15.000	83.000				

RSCH PLOT DATA

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>3"/B AGE	>3"/B PCI	AC OL AGE	AC OL PCI	BST AGE	BST PCI	SS AGE	SS PCI
0.000	100.000	0.000	100.000	0.000	100.000	0.000	100.000
13.000	83.000	13.000	96.000	12.000	61.000	17.000	60.000
17.000	75.000	16.000	91.000	15.000	34.000	21.000	55.000
13.000	86.000	10.000	89.000	2.000	82.000	17.000	53.000
17.000	80.000	13.000	84.000	5.000	60.000	21.000	43.000
18.000	81.000	13.000	88.000	1.000	98.000	7.000	72.000
21.000	68.000	17.000	83.000	4.000	95.000	11.000	70.000
2.000	90.000	1.000	97.000	2.000	79.000	2.000	68.000
6.000	86.000	5.000	90.000	6.000	46.000	6.000	49.000
27.000	93.000	3.000	89.000	2.000	58.000	12.000	88.000
31.000	91.000	7.000	81.000	6.000	50.000	15.000	70.000
		8.000	86.000	3.000	52.000	9.000	77.000
		11.000	84.000	6.000	42.000	12.000	72.000
		12.000	68.000	1.000	73.000	5.000	57.000
		15.000	65.000	4.000	68.000	8.000	40.000
		11.000	79.000	3.000	91.000	2.000	83.000
		15.000	74.000	7.000	88.000	6.000	77.000
		10.000	72.000	8.000	80.000	2.000	71.000
		13.000	58.000	12.000	77.000	6.000	68.000
		10.000	68.000			1.000	77.000
		13.000	59.000			5.000	57.000
		14.000	75.000			1.000	65.000
		17.000	70.000			5.000	64.000
		1.000	92.000				
		4.000	83.000				
		10.000	87.000				
		14.000	83.000				
		2.000	83.000				
		6.000	76.000				
		7.000	87.000				
		11.000	79.000				
		7.000	77.000				
		11.000	68.000				
		4.000	92.000				
		8.000	89.000				
		1.000	91.000				
		5.000	89.000				

PLOT DATA (WA)

Wed, Mar 4, 1992 2:44 PM

>3"/B AGE	>3"/B PCI	AC OL AGE	AC OL PCI	BST AGE	BST PCI	SS AGE	SS PCI
0.000	100.000	0.000	100.000	0.000	100.000	0.000	100.000
13.000	83.000	13.000	96.000	12.000	61.000	17.000	60.000
17.000	75.000	16.000	91.000	15.000	34.000	21.000	55.000
13.000	86.000	10.000	89.000	2.000	82.000	17.000	53.000
17.000	80.000	13.000	84.000	5.000	60.000	21.000	43.000
18.000	81.000	13.000	88.000	1.000	98.000	7.000	72.000
21.000	68.000	17.000	83.000	4.000	95.000	11.000	70.000
		1.000	97.000	2.000	79.000	2.000	68.000
		5.000	90.000	6.000	46.000	6.000	49.000
		3.000	89.000	2.000	58.000	12.000	88.000
		7.000	81.000	6.000	50.000	15.000	70.000
		8.000	86.000	3.000	52.000	9.000	77.000
		11.000	84.000	6.000	42.000	12.000	72.000
		12.000	68.000	1.000	73.000	5.000	57.000
		15.000	65.000	4.000	68.000	8.000	40.000
		11.000	79.000	3.000	91.000	2.000	83.000
		15.000	74.000	7.000	88.000	6.000	77.000
		10.000	72.000				
		13.000	58.000				
		10.000	68.000				
		13.000	59.000				
		14.000	75.000				
		17.000	70.000				
		1.000	92.000				
		4.000	83.000				

PLOT DATA (OR) Wed, Mar 4, 1992 2:39 PM

	2-3"AC/6-8B	2-3/6-8 PCI	2-3/>8 AGE	2-3/>8 PCI	>3"/B AGE	>3"/B PCI	AC OL AGE	AC OL PCI
1	37.000	79.000	0.000	100.000	0.000	100.000	0.000	100.000
2	41.000	75.000	1.000	96.000	27.000	93.000	10.000	87.000
3	23.000	88.000	5.000	92.000	31.000	91.000	14.000	83.000
4	27.000	83.000	1.000	95.000	2.000	90.000	2.000	83.000
5	4.000	88.000	5.000	90.000	6.000	86.000	6.000	76.000
6	8.000	77.000					7.000	87.000
7	2.000	92.000					11.000	79.000
8	6.000	88.000					7.000	77.000
9							11.000	68.000
0							4.000	92.000
1							8.000	89.000
2							1.000	91.000
3							5.000	89.000

PLOT DATA (OR) Wed, Mar 4, 1992 2:39 PM

	BST AGE	BST PCI	SS AGE	SS PCI	PCC AGE	PCC PCI
1	0.000	100.000	0.000	100.000	0.000	100.000
2	8.000	80.000	2.000	71.000	1.000	94.000
3	12.000	77.000	6.000	68.000	5.000	78.000
4			1.000	77.000		
5			5.000	57.000		
6			1.000	65.000		
7			5.000	64.000		
8						
9						
0						
1						
2						
3						

WASHINGTON PAVEMENTS

2 - 3 INCHES OF AC
ON
6 - 8 INCHES OF BASE

Includes:	Regression Equations
	R-squared (Confidence associated with the regression model)
	t-ratio (Predictability of the dependent variable from the independent variable) (Higher values better - typically > 4)
	s or SEE (Estimate error factor - lower values are better)

Notes:	c1 represents the dependent variable PCI.
	c2 represents the independent variable AGE.
	c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
	Equations with c6 and c7 are raised to the 3 and 3.5 powers.

WA 2-3"/6-8'

```
 regression equation is
= 99.1 - 2.14 C2

eictor          Coef           Stdev      t-ratio
ntant          99.11           11.58         8.56
             -2.1406          0.7703        -2.78

=19.20       R-sq = 34.0%       R-sq(adj) = 29.6%

aysis of Variance

UCE          DF           SS            MS
gession       1       2845.7        2845.7
rr           15       5528.2         368.5
tl           16       8373.9

ual Observations
s       C2          C1          Fit  Stdev.Fit   Residual    St.Resid
1      0.0      100.00        99.11      11.58       0.89       0.06 X
0     14.0       29.00        69.14       4.66     -40.14      -2.16R
1     18.0       18.00        60.58       5.69     -42.58      -2.32R

dnotes an obs. with a large st. resid.
NINUE?




T> 88 12
T> 83 15
T> end
  15 ROWS READ
B> regress c1 1 c2

eregression equation is
  99.8 - 1.78 C2

eictor          Coef           Stdev      t-ratio
ntant         99.827           6.669        14.97
             -1.7842          0.4481        -3.98

=10.99       R-sq = 54.9%       R-sq(adj) = 51.5%

aysis of Variance

UCE          DF           SS            MS
gession       1       1915.5        1915.5
r            13       1570.9         120.8
tl           14       3486.4


B>
```

```
T > let c3=c2**1.5
  > regress c1 1 c3

n regression equation is
1= 95.0 - 0.356 C3

edictor       Coef         Stdev      t-ratio
nstant      95.033         5.622        16.90
3         -0.35619       0.08980        -3.97

= 11.02       R-sq = 54.8%     R-sq(adj) = 51.3%

alysis of Variance

URCE       DF           SS            MS
gression    1       1908.9        1908.9
ror        13       1577.5         121.3
tal        14       3486.4



T >




T > regress c1 1 c4

n regression equation is
1= 91.7 - 0.0717 C4

edictor       Coef         Stdev      t-ratio
nstant      91.669         5.049        18.16
4         -0.07166       0.01868        -3.84

= 11.21       R-sq = 53.1%     R-sq(adj) = 49.5%

alysis of Variance

URCE       DF           SS            MS
gression    1       1851.4        1851.4
ror        13       1635.0         125.8
tal        14       3486.4

nsual Observations
bs      C4        C1       Fit Stdev.Fit   Residual   St.Resid
       576     51.00     50.40      7.23       0.60       0.07 X

enotes an obs. whose X value gives it large influence.

T >
```

```
T] > regress c1 1 c5

n regression equation is
1 = 89.1 - 0.0144 C5

dictor          Coef           Stdev     t-ratio
stant         89.150           4.691       19.01
5          -0.014438        0.003933       -3.67

 11.48        R-sq = 50.9%      R-sq(adj) = 47.1%

alysis of Variance

URCE         DF           SS           MS
ression       1       1774.6       1774.6
ror          13       1711.8        131.7
tal          14       3486.4

usual Observations
bs       C5         C1         Fit  Stdev.Fit   Residual    St.Resid
       2822      51.00       48.41       8.03       2.59      0.32 X

enotes an obs. whose X value gives it large influence.

T >



T > regress c1 1 c6

 regression equation is
1 = 87.2 - 0.00291 C6

edictor         Coef           Stdev     t-ratio
stant         87.192           4.449       19.60
6         -0.0029071       0.0008305       -3.50

 = 11.75        R-sq = 48.5%      R-sq(adj) = 44.6%

aysis of Variance

URCE         DF           SS           MS
ression       1       1691.6       1691.6
ror          13       1794.8        138.1
tal          14       3486.4

usual Observations
bs       C6         C1         Fit  Stdev.Fit   Residual    St.Resid
      13824      51.00       47.00       8.77       4.00      0.51 X

enotes an obs. whose X value gives it large influence.

T >
```

OREGON PAVEMENTS

2 - 3 INCHES OF AC
ON
6 - 8 INCHES OF BASE

Includes:

Regression Equations
R-squared (Confidence associated with the regression model)
t-ratio (Predictability of the dependent variable from the independent variable)
(Higher values better - typically > 4)
s or SEE (Estimate error factor - lower values are better)

Notes:

c1 represents the dependent variable PCI.
c2 represents the independent variable AGE.
c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
Equations with c6 and c7 are raised to the 3 and 3.5 powers.

```
 > regress c1 1 c2

ne regression equation is
1 = 91.5 - 0.361 C2

redictor         Coef          Stdev      t-ratio
onstant        91.486          2.926        31.27
2             -0.3607         0.1319        -2.73

= 5.890        R-sq = 51.6%      R-sq(adj) = 44.7%

nalysis of Variance

OURCE          DF          SS            MS
egression       1      259.39        259.39
rror            7      242.83         34.69
otal            8      502.22

nusual Observations
bs         C2          C1         Fit  Stdev.Fit   Residual    St.Resid
          8.0       77.00       88.60       2.26     -11.60      -2.13R

enotes an obs. with a large st. resid.

TB >


TB > regress c1 1 c3

he regression equation is
1 = 90.2 - 0.0533 C3

redictor         Coef          Stdev      t-ratio
onstant        90.216          2.767        32.61
3            -0.05334        0.02127        -2.51

 6.148        R-sq = 47.3%      R-sq(adj) = 39.8%

nalysis of Variance

URCE           DF          SS            MS
gression        1      237.67        237.67
ror             7      264.56         37.79
tal             8      502.22

usual Observations
s.         C3          C1         Fit  Stdev.Fit   Residual    St.Resid
           23       77.00       89.01       2.47     -12.01      -2.13R

enotes an obs. with a large st. resid.

 >
```

```
TB > regress c1 1 c4

he regression equation is
1 = 89.6 - 0.00829 C4

edictor        Coef          Stdev      t-ratio
onstant       89.635         2.674        33.52
4          -0.008293      0.003416        -2.43

 = 6.241      R-sq = 45.7%     R-sq(adj) = 38.0%

nalysis of Variance

OURCE        DF          SS           MS
egression     1        229.56       229.56
rror          7        272.66        38.95
otal          8        502.22

nusual Observations
bs.      C4        C1        Fit  Stdev.Fit   Residual    St.Resid
 7       64      77.00      89.10       2.54     -12.10      -2.12R

 denotes an obs. with a large st. resid.

TB >
```

```
 > regress c1 1 c5

he regression equation is
1 = 89.3 - 0.00130 C5

redictor       Coef          Stdev      t-ratio
onstant       89.285         2.613        34.17
5         -0.0013048     0.0005461        -2.39

 = 6.286      R-sq = 44.9%     R-sq(adj) = 37.1%

nalysis of Variance

URCE         DF          SS           MS
egression     1        225.61       225.61
rror          7        276.61        39.52
tal           8        502.22

nusual Observations
bs.      C5        C1        Fit  Stdev.Fit   Residual    St.Resid
 7      181      77.00      89.05       2.55     -12.05      -2.10R

 denotes an obs. with a large st. resid.

TB >
```

COMBINED PAVEMENTS

2 - 3 INCHES OF AC
ON
6 - 8 INCHES OF BASE

Includes:	Regression Equations
	R-squared (Confidence associated with the regression model)
	t-ratio (Predictability of the dependent variable from the independent variable) (Higher values better - typically > 4)
	s or SEE (Estimate error factor - lower values are better)

Notes:	c1 represents the dependent variable PCI.
	c2 represents the independent variable AGE.
	c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
	Equations with c6 and c7 are raised to the 3 and 3.5 powers.

COMBINED 2-3/6-8

```
e regression equation is
1 = 82.0 - 0.486 C2

edictor        Coef          Stdev     t-ratio
nstant       81.968          7.961       10.30
            -0.4855         0.4280       -1.13

 = 20.01        R-sq = 5.3%        R-sq(adj) = 1.2%

alysis of Variance

URCE         DF           SS            MS
gression      1        515.3         515.3
ror          23       9208.0         400.3
tal          24       9723.4

usual Observations
s.       C2          C1         Fit  Stdev.Fit    Residual    St.Resid
0      14.0       29.00       75.17       4.10      -46.17      -2.36R
1      18.0       18.00       73.23       4.09      -55.23      -2.82R
0      37.0       79.00       64.00       9.81       15.00       0.86 X
1      41.0       75.00       62.06      11.39       12.94       0.79 X

NTINUE?

e regression equation is
 = 77.7 - 0.0488 C3

edictor        Coef          Stdev     t-ratio
nstant       77.704          6.307       12.32
          -0.04879        0.06639       -0.73

 = 20.32        R-sq = 2.3%        R-sq(adj) = 0.0%

alysis of Variance

URCE         DF           SS            MS
gression      1        223.1         223.1
ror          23       9500.3         413.1
tal          24       9723.4

usual Observations
s.       C3          C1         Fit  Stdev.Fit    Residual    St.Resid
0        52       29.00       75.15       4.28      -46.15      -2.32R
1        76       18.00       73.98       4.07      -55.98      -2.81R
0       225       79.00       66.72      10.91       12.28       0.72 X
1       263       75.00       64.90      13.25       10.10       0.66 X

NTINUE?

e regression equation is
 = 75.8 - 0.0047 C4

edictor        Coef          Stdev     t-ratio
nstant       75.775          5.457       13.89
```

```
nalysis of Variance

OURCE          DF            SS            MS
egression       1          84.0          84.0
ror            23        9639.3         419.1
cal            24        9723.4

nusual Observations
bs.        C4          C1        Fit  Stdev.Fit   Residual    St.Resid
10        196       29.00      74.86       4.38     -45.86      -2.29R
11        324       18.00      74.26       4.10     -56.26      -2.81R
20       1369       79.00      69.38      11.42       9.62       0.57 X
21       1681       75.00      67.93      14.51       7.07       0.49 X

ONTINUE?


he regression equation is
 = 74.9 - 0.00041 C5

edictor         Coef          Stdev     t-ratio
onstant        74.864          4.992       15.00
        -0.000407       0.001642       -0.25

 = 20.53       R-sq = 0.3%       R-sq(adj) = 0.0%

alysis of Variance

URCE           DF            SS            MS
gression        1          25.9          25.9
ror            23        9697.5         421.6
tal            24        9723.4

usual Observations
s.         C5          C1        Fit  Stdev.Fit   Residual    St.Resid
0         733       29.00      74.57       4.42     -45.57      -2.27R
1        1375       18.00      74.30       4.15     -56.30      -2.80R
0        8327       79.00      71.48      11.58       7.52       0.44 X
1       10764       75.00      70.48      15.39       4.52       0.33 X

NTINUE?
```

COMBINED 2-5 / 6-8
W/O HIP's

```
e regression equation is
 = 99.2 - 1.99 C2

edictor        Coef          Stdev     t-ratio
nstant        99.17          11.55        8.59
            -1.9854         0.7712       -2.57

 = 19.65       R-sq = 28.0%     R-sq(adj) = 23.8%

alysis of Variance

URCE         DF          SS           MS
gression      1      2558.9       2558.9
ror          17      6564.3        386.1
tal          18      9123.2

usual Observations
s.       C2        C1        Fit Stdev.Fit   Residual    St.Resid
1       0.0    100.00      99.17     11.55       0.83       0.05 X
0      14.0     29.00      71.37      4.51     -42.37      -2.22R
1      18.0     18.00      63.43      5.56     -45.43      -2.41R

denotes an obs. with a large st. resid.
NTINUE?


e regression equation is
 = 93.8 - 0.398 C3

edictor        Coef          Stdev     t-ratio
nstant       93.753          9.721        9.64
            -0.3985         0.1561       -2.55

= 19.70        R-sq = 27.7%     R-sq(adj) = 23.4%

alysis of Variance

URCE         DF          SS           MS
gression      1      2527.0       2527.0
ror          17      6596.1        388.0
tal          18      9123.2

usual Observations
s.       C3        C1        Fit Stdev.Fit   Residual    St.Resid
0        52     29.00      72.88      4.54     -43.88      -2.29R
1        76     18.00      63.32      5.61     -45.32      -2.40R

denotes an obs. with a large st. resid.

9 >
```

```
he regression equation is
1 = 89.7 - 0.0797 C4

edictor        Coef          Stdev      t-ratio
nstant       89.669          8.574        10.46
4          -0.07971        0.03236        -2.46

 = 19.89         R-sq = 26.3%      R-sq(adj) = 22.0%

nalysis of Variance

OURCE         DF            SS            MS
egression      1        2399.6        2399.6
rror          17        6723.5         395.5
tal           18        9123.2

nusual Observations
bs.      C4          C1         Fit  Stdev.Fit   Residual    St.Resid
 7      576       51.00       43.76      12.26       7.24      0.46 X
10      196       29.00       74.05       4.65     -45.05     -2.33R
11      324       18.00       63.84       5.59     -45.84     -2.40R

 denotes an obs. with a large st. resid.
ONTINUE?




e regression equation is
 = 86.5 - 0.0159 C5

edictor        Coef          Stdev      t-ratio
nstant       86.482          7.778        11.12
5         -0.015860       0.006756        -2.35

 = 20.13         R-sq = 24.5%      R-sq(adj) = 20.0%

alysis of Variance

URCE          DF            SS            MS
gression       1        2233.6        2233.6
ror           17        6889.5         405.3
tal           18        9123.2

usual Observations
s.        C5          C1         Fit  Stdev.Fit   Residual    St.Resid
 7      2822       51.00       41.73      13.61       9.27      0.63 X
 0       733       29.00       74.85       4.80     -45.85     -2.35R
 1      1375       18.00       64.68       5.52     -46.68     -2.41R

 denotes an obs. with a large st. resid.
NTINUE?
```

WASHINGTON PAVEMENTS

2 - 3 INCHES OF AC
ON
GREATER THAN 8 INCHES OF BASE

WA 2-3 />8

```
3 > regress c1 1 c2

e regression equation is
 = 96.4 - 0.853 C2

edictor         Coef          Stdev      t-ratio
nstant        96.411          6.457        14.93
             -0.8526         0.4684        -1.82

= 11.87        R-sq = 20.3%     R-sq(adj) = 14.2%

alysis of Variance

URCE        DF           SS          MS
gression     1        466.5       466.5
ror         13       1830.5       140.8
tal         14       2296.9

usual Observations
s.       C2          C1        Fit  Stdev.Fit   Residual    St.Resid
5      21.0       48.00      78.51       5.16     -30.51     -2.86R

denotes an obs. with a large st. resid.

B >


B > regress c1 1 c2

e regression equation is
 = 94.6 - 0.877 C2

edictor         Coef          Stdev      t-ratio
nstant        94.596          6.148        15.39
             -0.8775         0.4547        -1.93

= 11.76        R-sq = 25.3%     R-sq(adj) = 18.5%

alysis of Variance

URCE        DF           SS          MS
gression     1        515.3       515.3
ror         11       1522.0       138.4
Ttal        12       2037.2

usual Observations
s.       C2          C1        Fit  Stdev.Fit   Residual    St.Resid
3      21.0       48.00      76.17       5.43     -28.17     -2.70R

denotes an obs. with a large st. resid.

3 >
```

```
TB > regress c1 1 c3

he regression equation is
 = 92.3 - 0.173 C3

edictor         Coef          Stdev      t-ratio
nstant        92.310          5.218        17.69
            -0.17349        0.09077        -1.91

= 11.79         R-sq = 24.9%      R-sq(adj) = 18.1%

alysis of Variance

URCE          DF            SS            MS
gression       1         507.9         507.9
ror           11        1529.4         139.0
tal           12        2037.2

usual Observations
s.        C3          C1         Fit  Stdev.Fit   Residual    St.Resid
3         96       48.00       75.61       5.70     -27.61      -2.68R

denotes an obs. with a large st. resid.

B >



B > regress c1 1 c4

 regression equation is
 = 91.1 - 0.0358 C4

edictor         Coef          Stdev      t-ratio
nstant        91.083          4.754        19.16
           -0.03579        0.01885        -1.90

= 11.81         R-sq = 24.7%      R-sq(adj) = 17.8%

alysis of Variance

URCE          DF            SS            MS
gression       1         503.0         503.0
ror           11        1534.2         139.5
tal           12        2037.2

usual Observations
s.        C4          C1         Fit  Stdev.Fit   Residual    St.Resid
3        441       48.00       75.30       5.86     -27.30      -2.66R

denotes an obs. with a large st. resid.

B >
```

```
B ) regress c1 1 c5

e regression equation is
 = 90.3 - 0.00748 C5

edictor         Coef            Stdev      t-ratio
nstant        90.294            4.490        20.11
           -0.007483         0.003981        -1.88

= 11.84        R-sq = 24.3%     R-sq(adj) = 17.4%

alysis of Variance

URCE          DF            SS           MS
gression       1         495.3        495.3
ror           11        1542.0        140.2
tal           12        2037.2

usual Observations
s.       C5          C1         Fit  Stdev.Fit   Residual    St.Resid
3      2021       48.00       75.17       5.97     -27.17      -2.66R

denotes an obs. with a large st. resid.

B )



e regression equation is
 = 89.7 - 0.00157 C6

edictor         Coef            Stdev      t-ratio
nstant        89.713            4.326        20.74
         -0.0015660        0.0008474        -1.85

= 11.89        R-sq = 23.7%     R-sq(adj) = 16.8%

alysis of Variance

URCE          DF            SS           MS
gression       1         482.6        482.6
ror           11        1554.6        141.3
tal           12        2037.2

usual Observations
s.       C6          C1         Fit  Stdev.Fit   Residual    St.Resid
5     12167       87.00       70.66       8.20      16.34       1.90 X
3      9261       48.00       75.21       6.03     -27.21      -2.66R

denotes an obs. with a large st. resid.
denotes an obs. whose X value gives it large influence.
B )
```

OREGON PAVEMENTS

2 - 3 INCHES OF AC
ON
GREATER THAN 8 INCHES OF BASE

OK 2-8/78

```
TA> 95 1
A> 90 5
TA> end
    5 ROWS READ
B > regress c1 1 c2

e regression equation is
 = 98.1 - 1.47 C2

edictor        Coef          Stdev      t-ratio
nstant       98.138          1.146        85.66
            -1.4741         0.3553        -4.15

= 1.711        R-sq = 85.2%      R-sq(adj) = 80.2%

alysis of Variance

URCE        DF          SS            MS
gression     1       50.416        50.416
ror          3        8.784         2.928
tal          4       59.200



B >




B > let c3=c2**1.5
B > regress c1 1 c3

e regression equation is
 = 97.5 - 0.590 C3

edictor        Coef          Stdev      t-ratio
nstant       97.476          1.267        76.92
            -0.5903         0.1785        -3.31

= 2.061        R-sq = 78.5%      R-sq(adj) = 71.3%

alysis of Variance

URCE        DF          SS            MS
ression      1       46.458        46.458
or           3       12.742         4.247
al           4       59.200



 >
```

```
B > regress c1 c4

ERROR * 2 IS TOO FEW ARGUMENTS

B > regress c1 1 c4

he regression equation is
 = 97.2 - 0.251 C4

edictor        Coef          Stdev     t-ratio
nstant       97.206          1.307       74.39
           -0.25056        0.08258       -3.03

= 2.202       R-sq = 75.4%      R-sq(adj) = 67.2%

alysis of Variance

URCE         DF          SS            MS
gression      1      44.650        44.650
ror           3      14.550         4.850
tal           4      59.200



B >




B > let c5=c2**2.5
B > regress c1 1 c5

e regression equation is
 = 97.1 - 0.109 C5

edictor        Coef          Stdev     t-ratio
nstant       97.091          1.322       73.44
           -0.10943        0.03739       -2.93

= 2.262       R-sq = 74.1%      R-sq(adj) = 65.4%

alysis of Variance

URCE         DF          SS            MS
gression      1      43.846        43.846
ror           3      15.354         5.118
al            4      59.200


B >
```

COMBINED PAVEMENTS

2 - 3 INCHES OF AC
ON
GREATER THAN 8 INCHES OF BASE

COMBINED 2-3 /78

```
3 > regress c1 1 c2

e regression equation is
 = 96.1 - 0.838 C2

edictor        Coef           Stdev     t-ratio
nstant       96.140           4.231       22.72
            -0.8384          0.3423       -2.45

= 10.39        R-sq = 26.1%      R-sq(adj) = 21.7%

lysis of Variance

URCE          DF              SS            MS
gression       1           647.5         647.5
ror           17          1835.1         107.9
al            18          2482.6

usual Observations
s.       C2         C1         Fit  Stdev.Fit   Residual    St.Resid
      21.0      48.00       78.53       4.40     -30.53      -3.24R

denotes an obs. with a large st. resid.

T  >



  > regress c1 1 c3

T  regression equation is
C = 94.3 - 0.174 C3

P dictor        Coef           Stdev     t-ratio
C start       94.303           3.599       26.20
C           -0.17450         0.07020       -2.49

s  10.35        R-sq = 26.7%      R-sq(adj) = 22.3%

Ar lysis of Variance

SO RCE          DF              SS            MS
Re ression       1           661.8         661.8
Er or           17          1820.8         107.1
To al           18          2482.6

Un sual Observations
Ob.       C3         C1         Fit  Stdev.Fit   Residual    St.Resid
 1        96      48.00       77.51       4.69     -29.51      -3.20R

R enotes an obs. with a large st. resid.

MT  >
```

```
e regression equation is
 = 93.3 - 0.0373 C4

edictor        Coef          Stdev     t-ratio
nstant       93.279          3.277       28.46
           -0.03732        0.01484       -2.51

= 10.32        R-sq = 27.1%      R-sq(adj) = 22.8%

alysis of Variance

URCE          DF          SS            MS
gression       1       673.1         673.1
ror           17      1809.5         106.4
tal           18      2482.6

usual Observations
s.       C4        C1         Fit  Stdev.Fit   Residual    St.Resid
 7      529     87.00       73.54       6.07      13.46       1.61 X
 5      441     48.00       76.82       4.89     -28.82      -3.17R

denotes an obs. with a large st. resid.
denotes an obs. whose X value gives it large influence.
3 >



 regression equation is
 = 92.6 - 0.00802 C5

dictor        Coef          Stdev     t-ratio
stant       92.602          3.087       30.00
         -0.008024       0.003172       -2.53

 10.30        R-sq = 27.4%      R-sq(adj) = 23.1%

lysis of Variance

IRCE          DF          SS            MS
ression        1       679.0         679.0
or            17      1803.6         106.1
al            18      2482.6

sual Observations
.        C5        C1         Fit  Stdev.Fit   Residual    St.Resid
       2537     87.00       72.25       6.51      14.75       1.85 X
 1     2021     48.00       76.39       5.02     -28.39      -3.16R

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.
 >
```

```
e regression equation is
 = 92.1 - 0.00172 C6

 edictor      Coef         Stdev     t-ratio
 nstant     92.097         2.965       31.07
        -0.0017187     0.0006805       -2.53

= 10.30       R-sq = 27.3%     R-sq(adj) = 23.0%

alysis of Variance

 URCE      DF           SS           MS
 gression   1        677.4        677.4
 ror       17       1805.2        106.2
 al        18       2482.6

usual Observations
s.      C6        C1       Fit Stdev.Fit  Residual   St.Resid
     12167     87.00     71.19      6.91     15.81      2.07RX
      9261     48.00     76.18      5.09    -28.18     -3.15R

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.
 >
```

COMBINED 2-5"/7
W/O HIP's

```
3 ) regress c1 1 c2

e regression equation is
 = 95.9 - 0.961 C2

edictor        Coef           Stdev     t-ratio
nstant        95.912          4.058       23.64
             -0.9606         0.3362       -2.86

= 9.947        R-sq = 35.2%      R-sq(adj) = 30.9%

alysis of Variance

URCE         DF            SS              MS
gression      1        807.95          807.95
ror          15       1484.17           98.94
al           16       2292.12

usual Observations
s.        C2          C1         Fit  Stdev.Fit   Residual    St.Resid
     21.0       48.00      75.74       4.50     -27.74      -3.13R

enotes an obs. with a large st. resid.

 )


 ) regress c1 1 c3

 regression equation is
 = 93.6 - 0.193 C3

dictor         Coef           Stdev     t-ratio
stant         93.640          3.515       26.64
            -0.19295        0.06937       -2.78

 10.04         R-sq = 34.0%      R-sq(adj) = 29.6%

lysis of Variance

RCE          DF            SS              MS
ression       1         780.0           780.0
or           15        1512.1           100.8
al           16        2292.1

sual Observations
.         C3          C1         Fit  Stdev.Fit   Residual    St.Resid
         96       48.00      75.07       4.80     -27.07      -3.07R

enotes an obs. with a large st. resid.

  )
```

```
e regression equation is
 = 92.4 - 0.0399 C4

dictor        Coef         Stdev     t-ratio
stant       92.402         3.267       28.28
          -0.03990       0.01476       -2.70

: 10.14       R-sq = 32.7%     R-sq(adj) = 28.3%

lysis of Variance

IRCE       DF          SS           MS
ression     1       750.7        750.7
or         15      1541.5        102.8
al         16      2292.1

sual Observations
t.     C4        C1        Fit Stdev.Fit  Residual    St.Resid
      529     87.00     71.29      6.17     15.71       1.95 X
1     441     48.00     74.81      5.01    -26.81      -3.04R

 enotes an obs. with a large st. resid.
 enotes an obs. whose X value gives it large influence.
7 >




h regression equation is
1= 91.6 - 0.00834 C5

rdictor        Coef         Stdev     t-ratio
cstant       91.622         3.136       29.22
5          -0.008339      0.003176       -2.63

  10.23       R-sq = 31.5%     R-sq(adj) = 26.9%

nlysis of Variance

ORCE       DF          SS           MS
eression    1       721.8        721.8
ror        15      1570.3        104.7
oal        16      2292.1

Unsual Observations
Ob.     C5        C1        Fit Stdev.Fit  Residual    St.Resid
      2537     87.00     70.47      6.62     16.53       2.12RX
1     2021     48.00     74.77      5.14    -26.77      -3.03R

R enotes an obs. with a large st. resid.
  enotes an obs. whose X value gives it large influence.
  >
```

WASHINGTON PAVEMENTS

GREATER THAN 3 INCHES OF AC
ON
ANY BASE

WA 7 5 AC/ANYBA:

```
TA)  81  18
TA)  68  21
TA)  end
     7 ROWS READ
 )  regress c1  1  c2

 regression equation is
 = 101  -  1.37  C2

dictor          Coef            Stdev      t-ratio
stant        101.287            3.223        31.43
             -1.3739           0.2080        -6.61

 3.486          R-sq  =  89.7%      R-sq(adj)  =  87.7%

lysis  of  Variance

RCE           DF              SS              MS
ression        1          530.11          530.11
or             5           60.75           12.15
al             6          590.86


T  )





T  )  let  c3=c2**1.5
T  )  regress  c1  1  c3

h  regression  equation  is
1=  99.8  -  0.309  C3

rdictor          Coef            Stdev      t-ratio
stant          99.800            2.612        38.20
3            -0.30895          0.04037        -7.65

  3.049          R-sq  =  92.1%      R-sq(adj)  =  90.6%

nlysis  of  Variance

CRCE           DF              SS              MS
eression        1          544.39          544.39
ror             5           46.47            9.29
oal             6          590.86


T  )
```

```
B > let c4=c2**2
9 > regress c1 1 c4

e regression equation is
 = 97.9 - 0.0668 C4

edictor         Coef           Stdev     t-ratio
nstant        97.902           2.629       37.24
           -0.066815        0.009612       -6.95

= 3.329        R-sq = 90.6%      R-sq(adj) = 88.7%

alysis of Variance

JRCE          DF          SS            MS
gression       1      535.45        535.45
ror            5       55.41         11.08
al             6      590.86


3 >





3 > let c5=c2**2.5
B > regress c1 1 c5

The regression equation is
C = 96.0 - 0.0142 C5

Predictor         Coef           Stdev     t-ratio
Constant        96.042           2.829       33.94
C5           -0.014191        0.002422       -5.86

s = 3.876        R-sq = 87.3%      R-sq(adj) = 84.7%

Analysis of Variance

SOURCE          DF          SS            MS
Regression       1      515.76        515.76
Error            5       75.10         15.02
Total            6      590.86


MTB >
```

OK 75 AG / ANY. BASIC

```
TA>  90 2
TA>  86 6
TA>  end
     5 ROWS READ
B )  regress c1 1 c2

e regression equation is
 = 92.7 - 0.051 C2

edictor          Coef            Stdev      t-ratio
nstant         92.676            3.733        24.83
              -0.0512           0.2007        -0.26

= 5.881        R-sq = 2.1%        R-sq(adj) = 0.0%

alysis of Variance

URCE          DF             SS              MS
gression       1           2.25            2.25
ror            3         103.75           34.58
al             4         106.00


 )




 )  let c3=c2**1.5
 )  regress c1 1 c3

 regression equation is
 = 92.3 - 0.0045 C3

 dictor          Coef            Stdev      t-ratio
 stant         92.299            3.541        26.07
             -0.00453          0.03551        -0.13

  5.928        R-sq = 0.5%        R-sq(adj) = 0.0%

 lysis of Variance

 RCE          DF             SS              MS
 ression       1           0.57            0.57
 or            3         105.43           35.14
 al            4         106.00


MT  )
```

OREGON PAVEMENTS

GREATER THAN 3 INCHES OF AC
ON
ANY BASE

UK / 3 AL
w/o HP

```
TA> 90 2
A> 86 6
TA> end
    3 ROWS READ
 > regress c1 1 c2

e regression equation is
 = 97.7 - 2.14 C2

edictor         Coef           Stdev     t-ratio
nstant        97.714           3.614       27.04
             -2.1429          0.9897       -2.17

= 4.276        R-sq = 82.4%      R-sq(adj) = 64.8%

alysis of Variance

URCE          DF           SS            MS
gression       1        85.71         85.71
ror            1        18.29         18.29
al             2       104.00



 > let c3=c2**1.5






 > let c3=c2**1.5
 > regress c1 1 c3

 regression equation is
 = 96.5 - 0.772 C3

dictor          Coef           Stdev     t-ratio
stant         96.507           4.404       21.91
             -0.7716          0.5097       -1.51

 5.621         R-sq = 69.6%      R-sq(adj) = 39.2%

lysis of Variance

RCE           DF           SS            MS
ression        1        72.40         72.40
or             1        31.60         31.60
al             2       104.00


T >
```

```
B > regress c1 1 c4

e regression equation is
 = 95.8 - 0.288 C4

edictor       Coef         Stdev     t-ratio
nstant      95.836         4.714       20.33
           -0.2877        0.2254       -1.28

= 6.290       R-sq = 62.0%    R-sq(adj) = 23.9%

alysis of Variance

URCE       DF           SS           MS
gression    1        64.44        64.44
ror         1        39.56        39.56
tal         2       104.00

usual Observations
s.      C4        C1        Fit  Stdev.Fit   Residual    St.Resid
3     36.0     86.00      85.48       6.27       0.52       1.00 X

denotes an obs. whose X value gives it large influence.

3 >



3 > regress c1 1 c5

e regression equation is
 = 95.5 - 0.111 C5

edictor       Coef         Stdev     t-ratio
nstant      95.469         4.852       19.68
          -0.11090       0.09510       -1.17

= 6.638       R-sq = 57.6%    R-sq(adj) = 15.3%

alysis of Variance

URCE       DF           SS           MS
gression    1        59.93        59.93
ror         1        44.07        44.07
al          2       104.00

usual Observations
s.      C5        C1        Fit  Stdev.Fit   Residual    St.Resid
      88.2     86.00      85.69       6.63       0.31       1.00 X

enotes an obs. whose X value gives it large influence.

 >
```

COMBINED PAVEMENTS

GREATER THAN 3 INCHES OF AC
ON
ANY BASE

COMBINED 12 AC/ANY DA

```
TA> 93 27
TA> 91 31
TA> end
    11 ROWS READ
3 > regress c1 1 c2

e regression equation is
 = 89.9 - 0.313 C2

edictor        Coef          Stdev      t-ratio
nstant       89.935          5.088        17.68
            -0.3131         0.2846        -1.10

 8.916       R-sq = 11.9%      R-sq(adj) = 2.1%

alysis of Variance

URCE         DF          SS            MS
ression       1       96.24         96.24
ror           9      715.40         79.49
al           10      811.64


T >




T > let c3=c2**1.5
T > regress c1 1 c3

h regression equation is
1= 87.5 - 0.0340 C3

rdictor        Coef          Stdev      t-ratio
stant        87.516          4.635        18.88
3          -0.03401        0.05380        -0.63

 9.292       R-sq = 4.3%       R-sq(adj) = 0.0%

nlysis of Variance

RCE          DF          SS            MS
eression      1       34.51         34.51
ror           9      777.12         86.35
al           10      811.64


 >
```

```
 ) let c4=c2**2
 ) regress c1 1 c4

 regression equation is
 = 86.1 - 0.00272 C4

dictor         Coef           Stdev      t-ratio
stant        86.051           4.264        20.18
          -0.002716        0.009915        -0.27

 9.457        R-sq = 0.8%       R-sq(adj) = 0.0%

lysis of Variance

RCE          DF            SS             MS
ression       1          6.72           6.72
or            9        804.92          89.44
al           10        811.64



T )

 ) regress c1 1 c5

 regression equation is
 = 85.2 + 0.00000 C5

rdictor        Coef           Stdev      t-ratio
stant        85.177           3.961        21.51
5          0.000003        0.001795         0.00

 9.496        R-sq = 0.0%       R-sq(adj) = 0.0%

nlysis of Variance

ORCE         DF            SS             MS
ression       1          0.00           0.00
ror           9        811.64          90.18
al           10        811.64

nsual Observations
b        C5          C1         Fit  Stdev.Fit   Residual    St.Resid
1      5351       91.00       85.19       7.44       5.81       0.98 X

enotes an obs. whose X value gives it large influence.

T )
```

COMBINED 73 AC/ANY RASH
w/o HIP

```
TA>  91  1
TA>  89  5
TA>  end
     9 ROWS READE
 > regress c1  1  c2

 regression equation is
 = 96.5 - 1.10 C2

edictor          Coef            Stdev     t-ratio
nstant         96.519            2.498       38.64
              -1.1017           0.1814       -6.07

 3.982         R-sq = 84.0%     R-sq(adj) = 81.8%

alysis of Variance

URCE          DF           SS             MS
gression       1       584.98         584.98
ror            7       111.02          15.86
al             8       696.00


 >





 > let c3=c2**1.5
 > regress c1  1  c3

 regression equation is
1= 95.0 - 0.244 C3

rdictor          Coef            Stdev     t-ratio
stant          95.022            2.196       43.28
             -0.24407          0.03839       -6.36

  3.831        R-sq = 85.2%     R-sq(adj) = 83.1%

rlysis of Variance

CRCE          DF           SS             MS
eression       1       593.27         593.27
ror            7       102.73          14.68
al             8       696.00


 >
```

```
B > let c4=c2**2
B > regress c1 1 c4 .

Te regression equation is
C = 94.0 - 0.0544 C4

edictor          Coef          Stdev      t-ratio
nstant         93.993          2.055        45.74
C           -0.054443       0.008515        -6.39

s= 3.813         R-sq = 85.4%      R-sq(adj) = 83.3%

alysis of Variance

SURCE          DF           SS            MS
Rgression       1       594.24        594.24
Eror            7       101.76         14.54
Ttal            8       696.00


MB >


MB > regress c1 1 c5

e regression equation is
C = 93.1 - 0.0121 C5

edictor          Coef          Stdev      t-ratio
nstant         93.139          2.011        46.31
C           -0.012085       0.001952        -6.19

s= 3.918         R-sq = 84.6%      R-sq(adj) = 82.4%

alysis of Variance

SURCE          DF           SS            MS
Rgression       1       588.56        588.56
Eror            7       107.44         15.35
Tal             8       696.00

usual Observations
s.        C5          C1         Fit  Stdev.Fit   Residual    St.Resid
1          0      100.00       93.14       2.01       6.86       2.04R

R denotes an obs. with a large st. resid.

M >
```

WORLD WAR TWO
PAVEMENTS

Includes:	Regression Equations
	R-squared (Confidence associated with the regression model)
	t-ratio (Predictability of the dependent variable from the independent variable) (Higher values better - typically > 4)
	s or SEE (Estimate error factor - lower values are better)

Notes:

c1 represents the dependent variable PCI.

c2 represents the independent variable AGE.

c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.

Equations with c6 and c7 are raised to the 3 and 3.5 powers.

WWII ALL

```
 regression equation is
 = 101 - 1.08 C2

edictor          Coef            Stdev      t-ratio
nstant         100.83            10.00        10.08
              -1.0820           0.2313        -4.68

 10.09          R-sq = 70.9%      R-sq(adj) = 67.6%

alysis of Variance

URCE           DF             SS             MS
gression        1         2226.2         2226.2
ror             9          915.9          101.8
al             10         3142.2

usual Observations
.          C2          C1          Fit  Stdev.Fit    Residual    St.Resid
          0.0      100.00       100.83      10.00       -0.83       -0.63 X
         43.0       77.00        54.31       3.07       22.69        2.36R

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.
 )




 regression equation is
1= 101 - 0.160 C3

dictor           Coef            Stdev      t-ratio
stant         100.601            9.732        10.34
             -0.15982          0.03339        -4.79

 9.923          R-sq = 71.8%      R-sq(adj) = 68.7%

lysis of Variance

RCE            DF             SS             MS
ression         1         2256.0         2256.0
or              9          886.2           98.5
al             10         3142.2

sual Observations
.          C3          C1          Fit  Stdev.Fit    Residual    St.Resid
            0      100.00       100.60       9.73       -0.60       -0.31 X
          282       77.00        55.54       3.00       21.46        2.27R

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.
T )
```

```
e regression equation is
 = 100 - 0.0234 C4

edictor         Coef          Stdev     t-ratio
nstant        99.973          9.544       10.47
           -0.023384       0.004852       -4.82

= 9.875         R-sq = 72.1%      R-sq(adj) = 69.0%

alysis of Variance

URCE         DF          SS          MS
gression      1      2264.6      2264.6
ror           9       877.6        97.5
tal          10      3142.2

usual Observations
s.       C4        C1        Fit  Stdev.Fit   Residual    St.Resid
 1        0    100.00      99.97       9.54       0.03      0.01 X
0      1849     77.00      56.74       2.98      20.26      2.15R

denotes an obs. with a large st. resid.
denotes an obs. whose X value gives it large influence.
B >




 regression equation is
 = 99.0 - 0.00339 C5

edictor         Coef          Stdev     t-ratio
nstant        98.996          9.431       10.50
          -0.0033914      0.0007099       -4.78

= 9.937         R-sq = 71.7%      R-sq(adj) = 68.6%

alysis of Variance

URCE         DF          SS          MS
gression      1      2253.6      2253.6
ror           9       888.6        98.7
al           10      3142.2

usual Observations
s.        C5        C1        Fit  Stdev.Fit   Residual    St.Resid
           0    100.00      99.00       9.43       1.00      0.32 X
1      12125     77.00      57.88       3.01      19.12      2.02R

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.
 >
```

WASHINGTON

AC OVERLAY
PAVEMENTS

Includes:	Regression Equations
	R-squared (Confidence associated with the regression model)
	t-ratio (Predictability of the dependent variable from the independent variable) (Higher values better - typically > 4)
	s or SEE (Estimate error factor - lower values are better)

Notes:	c1 represents the dependent variable PCI.
	c2 represents the independent variable AGE.
	c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
	Equations with c6 and c7 are raised to the 3 and 3.5 powers.

WA AG UL

```
TA>  92  1
TA>  83  4
TA>  end
    25 ROWS READ
 > regress c1  1  c2

e regression equation is
 = 93.2 - 1.23 C2

edictor          Coef            Stdev      t-ratio
nstant         93.248            4.476        20.83
              -1.2309           0.3971        -3.10

 = 10.01        R-sq = 29.5%       R-sq(adj) = 26.4%

alysis of Variance

URCE          DF            SS             MS
gression       1         963.4          963.4
ror           23        2305.9          100.3
al            24        3269.4


 >


A>  92  1
A>  83  4
A>  end
    18 ROWS READ
 > regress c1  1  c2

e regression equation is
 = 94.8 - 1.86 C2

edictor          Coef            Stdev      t-ratio
nstant         94.822            3.544        26.75
              -1.8635           0.3342        -5.58

 = 6.837        R-sq = 66.0%       R-sq(adj) = 63.9%

alysis of Variance

URCE          DF            SS             MS
gression       1        1453.1         1453.1
ror           16         748.0           46.7
al            17        2201.1


 >
```

```
RROR * COMPLETION OF COMPUTATION IMPOSSIBLE

 ) let c3=c2**1.5
 ) regress c1 1 c3

 regression equation is
1 = 90.7 - 0.421 C3

dictor          Coef          Stdev      t-ratio
stant         90.728          3.138        28.92
            -0.42081        0.08214        -5.12

 7.218        R-sq = 62.1%      R-sq(adj) = 59.8%

lysis of Variance

RCE          DF          SS           MS
ression       1      1367.5       1367.5
or           16       833.7         52.1
al           17      2201.1



T )




T ) let c4=c2**2
T ) regress c1 1 c4

 regression equation is
1= 88.2 - 0.0980 C4

dictor          Coef          Stdev      t-ratio
stant         88.245          3.011        29.31
            -0.09803        0.02135        -4.59

 7.705        R-sq = 56.8%      R-sq(adj) = 54.1%

lysis of Variance

RCE          DF          SS           MS
ression       1      1251.3       1251.3
or           16       949.9         59.4
al           17      2201.1


T )
```

```
B > regress c1 1 c5

e regression equation is
= 86.5 - 0.0230 C5

edictor      Coef          Stdev     t-ratio
nstant     86.460          2.969       29.13
        -0.022978       0.005608       -4.10

= 8.193       R-sq = 51.2%      R-sq(adj) = 48.2%

alysis of Variance

URCE        DF            SS           MS
gression     1        1127.0       1127.0
ror         16        1074.1         67.1
al          17        2201.1

usual Observations
s.     C5        C1        Fit Stdev.Fit   Residual    St.Resid
5    1192     70.00      59.08      4.83      10.92        1.65 X

enotes an obs. whose X value gives it large influence.

B >
```

WA ACOL W/O HIF

```
A> 92 1
A> 83 4
A> end
   19 ROWS READ
 > regress c1 1 c2

 regression equation is
 = 95.9 - 1.96 C2

edictor         Coef          Stdev     t-ratio
nstant        95.919          3.096       30.99
             -1.9556         0.2999       -6.52

 6.726       R-sq = 71.4%     R-sq(adj) = 69.8%

nlysis of Variance

URCE          DF          SS            MS
gression       1      1923.5        1923.5
ror           17       769.1          45.2
al            18      2692.6


 >





 > let c3=-c2**1.5
 > regress c1 1 c3

 regression equation is
= 92.2 + 0.453 C3

dictor          Coef          Stdev     t-ratio
stant         92.202          2.910       31.68
             0.45322        0.07827        5.79

 7.300       R-sq = 66.4%     R-sq(adj) = 64.4%

lysis of Variance

RCE           DF          SS            MS
ression        1      1786.7        1786.7
or            17       906.0          53.3
al            18      2692.6


 >
```

```
 > let c4=c2**2
 > regress c1 1 c4

 regression equation is
= 89.8 - 0.107 C4

dictor         Coef           Stdev      t-ratio
stant        89.802           2.887        31.11
           -0.10684         0.02104        -5.08

 7.933         R-sq = 60.3%      R-sq(adj) = 57.9%

lysis of Variance

RCE          DF          SS            MS
ression       1      1622.9        1622.9
or           17      1069.7          62.9
al           18      2692.6



T >



T > regress c1 1 c5

 regression equation is
1= 88.0 - 0.0252 C5

rdictor        Coef           Stdev      t-ratio
stant        88.031           2.905        30.31
5         -0.025232        0.005638        -4.48

 8.527         R-sq = 54.1%      R-sq(adj) = 51.4%

lysis of Variance

RCE          DF          SS            MS
ression       1      1456.5        1456.5
ror          17      1236.1          72.7
al           18      2692.6

nsual Observations
b.       C5         C1         Fit  Stdev.Fit   Residual    St.Resid
1      1192      70.00       57.97       4.97      12.03       1.74 X

 enotes an obs. whose X value gives it large influence.

T >
```

OREGON

AC OVERLAY PAVEMENTS

Includes: Regression Equations
R-squared (Confidence associated with the regression model)
t-ratio (Predictability of the dependent variable from the independent variable)
(Higher values better - typically > 4)
s or SEE (Estimate error factor - lower values are better)

Notes: c1 represents the dependent variable PCI.
c2 represents the independent variable AGE.
c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
Equations with c6 and c7 are raised to the 3 and 3.5 powers.

Ot AC OL

```
A>  91  1
A>  89  5
A>  end
   13  ROWS  READ
 >  regress  c1  1  c2

 regression  equation  is
=  92.4  -  1.17  C2

dictor          Coef            Stdev      t-ratio
stant         92.409            3.712        24.89
             -1.1664           0.4786        -2.44

 6.986        R-sq  =  35.1%      R-sq(adj)  =  29.2%

lysis  of  Variance

IRCE          DF              SS              MS
ression        1          289.90          289.90
or            11          536.87           48.81
al            12          826.77


 >




 >  let  c3=c2**1.5
 >  regress  c1  1  c3

 regression  equation  is
=  90.2  -  0.281  C3

dictor          Coef            Stdev      t-ratio
stant         90.187            3.289        27.42
             -0.2808           0.1324        -2.12

 7.304        R-sq  =  29.0%      R-sq(adj)  =  22.6%

lysis  of  Variance

RCE           DF              SS              MS
ression        1          239.88          239.88
or            11          586.89           53.35
al            12          826.77


 >
```

```
 > regress c1 1 c4

e regression equation is
 = 88.9 - 0.0691 C4

edictor      Coef         Stdev     t-ratio
nstant     88.851         3.054       29.09
         -0.06914       0.03696       -1.87

= 7.551       R-sq = 24.1%     R-sq(adj) = 17.2%

alysis of Variance

URCE       DF            SS           MS
gression    1        199.55       199.55
ror        11        627.22        57.02
al         12        826.77

usual Observations
s.     C4         C1         Fit  Stdev.Fit   Residual   St.Resid
      196      83.00       75.30       5.44       7.70       1.47 X

enotes an obs. whose X value gives it large influence.

 >


 > regress c1 1 c5

 regression equation is
= 88.0 - 0.0171 C5

edictor      Coef         Stdev     t-ratio
nstant     87.953         2.908       30.24
         -0.01712       0.01029       -1.66

 7.749        R-sq = 20.1%     R-sq(adj) = 12.8%

alysis of Variance

URCE       DF            SS           MS
eression    1        166.23       166.23
ror        11        660.54        60.05
al         12        826.77

usual Observations
.      C5         C1         Fit  Stdev.Fit   Residual   St.Resid
      733      83.00       75.40       5.99       7.60       1.55 X

enotes an obs. whose X value gives it large influence.

 >
```

OR AC OL
W/o HIF

```
A)  91  1
A)  89  5
A)  end
   11  ROWS  READ
 >  regress  c1  1  c2

 regression  equation  is
 =  94.7  -  1.79  C2

edictor       Coef         Stdev     t-ratio
stant       94.727         3.701       25.60
           -1.7903        0.5567       -3.22

 6.506        R-sq  =  53.5%     R-sq(adj)  =  48.3%

lysis  of  Variance

RCE        DF          SS            MS
ression     1      437.64        437.64
ror         9      380.90         42.32
al         10      818.55


 >





 >  let  c3=c2**1.5
 >  regress  c1  1  c3

 regression  equation  is
 =  92.5  -  0.507  C3

dictor        Coef         Stdev     t-ratio
stant       92.482         3.243       28.52
           -0.5066        0.1645       -3.08

 6.655        R-sq  =  51.3%     R-sq(adj)  =  45.9%

lysis  of  Variance

RCE        DF          SS            MS
ression     1      420.00        420.00
ror         9      398.55         44.28
al         10      818.55


 >
```

```
B > let c4=c2**2
B > regress c1 1 c4

e regression equation is
 = 91.1 - 0.146 C4

edictor        Coef         Stdev     t-ratio
nstant       91.084         2.996       30.40
           -0.14593       0.04945       -2.95

= 6.799       R-sq = 49.2%     R-sq(adj) = 43.5%

alysis of Variance

URCE        DF          SS          MS
gression     1      402.51      402.51
ror          9      416.04       46.23
al          10      818.55


B >




B > let c5=c2**2.5
B > regress c1 1 c5

 regression equation is
= 90.1 - 0.0423 C5

edictor        Coef         Stdev     t-ratio
stant        90.115         2.850       31.62
           -0.04227       0.01494       -2.83

 6.937       R-sq = 47.1%     R-sq(adj) = 41.2%

alysis of Variance

URCE        DF          SS          MS
ression      1      385.40      385.40
ror          9      433.15       48.13
al          10      818.55


B >
```

COMBINED

AC OVERLAY
PAVEMENTS

Includes:	Regression Equations
	R-squared (Confidence associated with the regression model)
	t-ratio (Predictability of the dependent variable from the independent variable) (Higher values better - typically > 4)
	s or SEE (Estimate error factor - lower values are better)

Notes:	c1 represents the dependent variable PCI.
	c2 represents the independent variable AGE.
	c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
	Equations with c6 and c7 are raised to the 3 and 3.5 powers.

AC OL COMBINEL

```
e regression equation is
  = 90.8 - 1.03 C2

edictor         Coef           Stdev     t-ratio
nstant        90.837           3.427       26.50
             -1.0284          0.3247       -3.17

 = 9.332        R-sq = 23.3%      R-sq(adj) = 21.0%

alysis of Variance

URCE         DF            SS            MS
gression      1        873.69        873.69
ror          33       2873.91         87.09
al           34       3747.60

usual Observations
s.       C2           C1          Fit  Stdev.Fit    Residual    St.Resid
       13.0        96.00        77.47       1.97       18.53       2.03R
       13.0        58.00        77.47       1.97      -19.47      -2.13R
       13.0        59.00        77.47       1.97      -18.47      -2.02R

lenotes an obs. with a large st. resid.
 )



e regression equation is
 = 88.4 - 0.226 C3

edictor         Coef           Stdev     t-ratio
nstant        88.394           2.941       30.06
            -0.22597         0.07739       -2.92

 9.500          R-sq = 20.5%      R-so(adj) = 18.1%

alysis of Variance

URCE         DF            SS            MS
ression       1        769.43        769.43
ror          33       2978.17         90.25
al           34       3747.60

usual Observations
.        C3           C1          Fit  Stdev.Fit    Residual    St.Resid
       46.9        58.00        77.80       1.98      -19.80      -2.13R
       46.9        59.00        77.80       1.98      -18.80      -2.02R

 enotes an obs. with a large st. resid.

 )
```

```
 regression equation is
 = 86.9 - 0.0513 C4

edictor        Coef          Stdev      t-ratio
nstant       86.917          2.684        32.38
           -0.05131        0.01913        -2.68

 9.656       R-sq = 17.9%      R-sq(adj) = 15.4%

lysis of Variance

RCE          DF          SS             MS
ression       1       670.94         670.94
or           33      3076.66          93.23
al           34      3747.60

sual Observations
.        C4         C1         Fit  Stdev.Fit   Residual    St.Resid
        169      58.00       78.25       1.97     -20.25      -2.14R
        169      59.00       78.25       1.97     -19.25      -2.04R

enotes an obs. with a large st. resid.

 >




 regression equation is
1= 85.9 - 0.0117 C5

dictor         Coef          Stdev      t-ratio
stant        85.873          2.521        34.06
          -0.011740       0.004776        -2.46

 9.797       R-sq = 15.5%      R-sq(adj) = 12.9%

lysis of Variance

RCE          DF          SS             MS
ression       1       579.97         579.97
or           33      3167.63          95.99
al           34      3747.60

sual Observations
.        C5         C1         Fit  Stdev.Fit   Residual    St.Resid
       1192      83.00       71.88       4.14      11.12       1.25 X
1       609      58.00       78.72       1.94     -20.72      -2.16R
        609      59.00       78.72       1.94     -19.72      -2.05R
       1192      70.00       71.88       4.14      -1.88      -0.21 X

TINUE?
```

ACOL COMBINE
W/o HIP

```
 > regress c1 1 c2

 regression equation is
= 94.9 - 1.86 C2

dictor        Coef          Stdev      t-ratio
stant       94.921          2.354        40.33
           -1.8609         0.2530        -7.36

 6.470       R-sq = 66.7%      R-sq(adj) = 65.5%

lysis of Variance

RCE          DF          SS          MS
ression       1       2264.7      2264.7
or           27       1130.3        41.9
al           28       3395.0

sual Observations
.        C2        C1        Fit  Stdev.Fit   Residual   St.Resid
      13.0     58.00      70.73       1.74     -12.73     -2.04R

enotes an obs. with a large st. resid.

 >



 > regress c1 1 c3

 regression equation is
= 91.3 - 0.438 C3

dictor        Coef          Stdev      t-ratio
stant       91.322          2.076        43.99
          -0.43759        0.06398        -6.84

 6.783       R-sq = 63.4%      R-sq(adj) = 62.1%

lysis of Variance

RCE          DF          SS          MS
ression       1       2152.6      2152.6
or           27       1242.3        46.0
al           28       3395.0

sual Observations
s        C3        C1        Fit  Stdev.Fit   Residual   St.Resid
1     70.1     70.00      60.65       3.10       9.35      1.55 X

enotes an obs. whose X value gives it large influence.

 >
```

```
 > regress c1 1 c4

e regression equation is
 = 89.1 - 0.105 C4

edictor        Coef          Stdev     t-ratio
nstant       89.113          1.987       44.85
           -0.10490        0.01696       -6.19

 7.212       R-sq = 58.6%      R-sq(adj) = 57.1%

alysis of Variance

URCE          DF           SS           MS
gression       1       1990.7       1990.7
ror           27       1404.3         52.0
al            28       3395.0

usual Observations
s.        C4        C1       Fit  Stdev.Fit   Residual    St.Resid
         289     70.00     58.80       3.68      11.20       1.81 X

enotes an obs. whose X value gives it large influence.

 >



 > regress c1 1 c5

 regression equation is
 = 87.6 - 0.0252 C5

edictor        Coef          Stdev     t-ratio
nstant       87.557          1.963       44.61
          -0.025186       0.004530       -5.56

 7.656       R-sq = 53.4%      R-sq(adj) = 51.7%

alysis of Variance

URCE          DF           SS           MS
ression        1       1812.3       1812.3
ror           27       1582.7         58.6
al            28       3395.0

usual Observations
.         C5        C1       Fit  Stdev.Fit   Residual    St.Resid
        1192     70.00     57.55       4.29      12.45       1.96 X

enotes an obs. whose X value gives it large influence.

 >
```

WASHINGTON

BITUMINOUS SURFACE TREATMENT PAVEMENTS

Includes:
Regression Equations
R-squared (Confidence associated with the regression model)
t-ratio (Predictability of the dependent variable from the independent variable)
(Higher values better - typically > 4)
s or SEE (Estimate error factor - lower values are better)

Notes:
c1 represents the dependent variable PCI.
c2 represents the independent variable AGE.
c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
Equations with c6 and c7 are raised to the 3 and 3.5 powers.

W/A BST UPPER
PORTION

```
A>  98  1
A>  95  4
A>  end
    7 ROWS READ
 )  regress c1  1  c2

 regression equation is
1= 106 - 4.13 C2

dictor          Coef          Stdev     t-ratio
stant        105.781          4.661       22.70
2            -4.1302         0.5852       -7.06

 8.109        R-sq = 90.9%     R-sq(adj) = 89.1%

lysis of Variance

RCE          DF           SS            MS
ression       1       3275.3        3275.3
ror           5        328.7          65.7
al            6       3604.0


T  >







T  >  let c3=c2**1.5
T  >  regress c1  1  c3

h  regression equation is
1= 101 - 1.07 C3

rdictor         Coef          Stdev     t-ratio
stant        101.262          2.507       40.39
3           -1.07143        0.08913      -12.02

 4.910        R-sq = 96.7%     R-sq(adj) = 96.0%

lysis of Variance

RCE          DF           SS            MS
ression       1       3483.5        3483.5
ror           5        120.5          24.1
al            6       3604.0


T  >
```

```
3 >  let c4=c2**2
3 >  regress c1 1 c4

e regression equation is
 = 98.6 - 0.278 C4

edictor       Coef         Stdev     t-ratio
nstant      98.647         1.488       66.32
          -0.27822       0.01446      -19.24

 = 3.099      R-sq = 98.7%     R-sq(adj) = 98.4%

alysis of Variance

URCE       DF           SS           MS
gression    1       3556.0       3556.0
ror         5         48.0          9.6
al          6       3604.0


3 >




 >  regress c1 1 c5

e regression equation is
 = 97.0 - 0.0723 C5

edictor       Coef         Stdev     t-ratio
nstant      96.984         1.210       80.16
         -0.072257      0.003160      -22.87

 = 2.613      R-sq = 99.1%     R-sq(adj) = 98.9%

alysis of Variance

URCE       DF           SS           MS
gression    1       3569.9       3569.9
ror         5         34.1          6.8
al          6       3604.0

usual Observations
b.      C5          C1         Fit Stdev.Fit   Residual    St.Resid
        16      91.000      95.858     1.182     -4.858      -2.08R

enotes an obs. with a large st. resid.

 >
```

```
denotes an obs. with a large st. resid.

 > let c6=c2**3
 > regress c1 1 c6

 regression equation is
 = 95.8 - 0.0187 C6

dictor         Coef          Stdev     t-ratio
stant        95.826          1.445       66.33
          -0.018739       0.001004      -18.67

 3.193        R-sq = 98.6%      R-sq(adj) = 98.3%

lysis of Variance

RCE         DF          SS           MS
ression      1      3553.0       3553.0
ror          5        51.0         10.2
al           6      3604.0


 >
```

WA DST LOWER
PORTION

```
A) 73 1
A) 68 4
A) end
   11 ROWS READ
 ) regress c1 1 c2

 regression equation is
1= 87.8 - 6.90 C2

 dictor       Coef          Stdev     t-ratio
 stant      87.756          5.851       15.00
            -6.900          1.484      -4.65

  10.12       R-sq = 70.6%     R-sq(adj) = 67.3%

 lysis of Variance

 RCE       DF           SS           MS
 ression    1       2216.3       2216.3
 or         9        922.4        102.5
 al        10       3138.7


T )




T ) let c3=c2**1.5
T ) regress c1 1 c3

h regression equation is
1= 81.9 - 2.45 C3

 dictor       Coef          Stdev     t-ratio
 stant      81.934          5.448       15.04
           -2.4537         0.6060      -4.05

  11.12       R-sq = 64.6%     R-sq(adj) = 60.6%

 lysis of Variance

 RCE       DF           SS           MS
 ression    1       2026.4       2026.4
 or         9       1112.3        123.6
 al        10       3138.7


T )
```

```
 > regress c1 1 c4

 regression equation is
 = 78.9 - 0.921 C4

dictor         Coef          Stdev     t-ratio
stant        78.867          5.227       15.09
            -0.9213         0.2477       -3.72

 11.72        R-sq = 60.6%      R-sq(adj) = 56.2%

lysis of Variance

RCE          DF           SS             MS
ression       1       1901.7         1901.7
or            9       1237.0          137.4
al           10       3138.7

sual Observations
.        C4         C1        Fit  Stdev.Fit   Residual    St.Resid
        0.0     100.00      78.87       5.23      21.13       2.01R

enotes an obs. with a large st. resid.

 >




 > regress c1 1 c5

 regression equation is
 = 77.1 - 0.357 C5

dictor         Coef          Stdev     t-ratio
stant        77.069          5.100       15.11
            -0.3569         0.1014       -3.52

 12.12        R-sq = 57.9%      R-sq(adj) = 53.2%

lysis of Variance

RCE          DF           SS             MS
ression       1       1817.7         1817.7
or            9       1321.0          146.8
al           10       3138.7

sual Observations
.        C5         C1        Fit  Stdev.Fit   Residual    St.Resid
        0.0     100.00      77.07       5.10      22.93       2.09R

enotes an obs. with a large st. resid.

 >
```

OREGON

BITUMINOUS SURFACE TREATMENT PAVEMENTS

Includes:	Regression Equations
	R-squared (Confidence associated with the regression model)
	t-ratio (Predictability of the dependent variable from the independent variable)
	(Higher values better - typically > 4)
	s or SEE (Estimate error factor - lower values are better)

Notes:	c1 represents the dependent variable PCI.
	c2 represents the independent variable AGE.
	c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
	Equations with c6 and c7 are raised to the 3 and 3.5 powers.

OREGON BST

```
A>  80 8
A>  77 12
A>  end
    3 ROWS READ
 >  regress c1 1 c2

 regression equation is
 = 99.0 - 2.00 C2

dictor         Coef            Stdev      t-ratio
stant        99.000            3.606        27.46
            -2.0000           0.4330        -4.62

 3.742         R-sq = 95.5%       R-sq(adj) = 91.0%

lysis of Variance

RCE          DF          SS            MS
ression       1      298.67        298.67
or            1       14.00         14.00
al            2      312.67



T  >



T  >  plot c1 c2

       -
       -  *
  98.0+
       -
       -
       -
       -
  91.0+
       -
       -
       -
       -
  84.0+
       -
       -
       -                                 *
       -
  77.0+                                                 *
       -
        +---------+---------+---------+---------+---------+------C2
      0.0       2.5       5.0       7.5      10.0      12.5

T  >
```

COMBINED

BITUMINOUS SURFACE TREATMENT PAVEMENTS

Includes:	Regression Equations
	R-squared (Confidence associated with the regression model)
	t-ratio (Predictability of the dependent variable from the independent variable) (Higher values better - typically > 4)
	s or SEE (Estimate error factor - lower values are better)

Notes:	c1 represents the dependent variable PCI.
	c2 represents the independent variable AGE.
	c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
	Equations with c6 and c7 are raised to the 3 and 3.5 powers.

EST COMBINED UPPER
PORTION

```
T > regress c1 1 c2

e regression equation is
1 = 105 - 3.62 C2

rdictor        Coef          Stdev      t-ratio
stant       105.396          5.544        19.01
2           -3.6220         0.6513        -5.56

 9.768       R-sq = 81.5%      R-sq(adj) = 78.9%

lysis of Variance

RCE         DF         SS           MS
ression      1      2950.3       2950.3
or           7       667.9         95.4
al           8      3618.2

sual Observations
b.      C2          C1        Fit  Stdev.Fit   Residual    St.Resid
      15.0       34.00      51.07       6.21     -17.07      -2.26R

enotes an obs. with a large st. resid.

T >



 regression equation is
1 = 101 - 0.956 C3

rdictor        Coef          Stdev      t-ratio
stant       101.324          3.921        25.84
3           -0.9560         0.1334        -7.17

 7.874       R-sq = 88.0%      R-sq(adj) = 86.3%

lysis of Variance

RCE         DF         SS           MS
ression      1      3184.2       3184.2
or           7       434.0         62.0
al           8      3618.2

sual Observations
b.      C3          C1        Fit  Stdev.Fit   Residual    St.Resid
      58.1       34.00      45.79       5.50     -11.79      -2.09R
      41.6       77.00      61.59       3.72      15.41       2.22R

enotes an obs. with a large st. resid.

 >
```

```
T > regress c1 1 c4

 regression equation is
1= 98.7 - 0.253 C4

dictor       Coef         Stdev     t-ratio
stant      98.744         3.116       31.69
4        -0.25260       0.02972       -8.50

 6.757       R-sq = 91.2%     R-sq(adj) = 89.9%

lysis of Variance

RCE       DF          SS          MS
ression    1      3298.6      3298.6
or         7       319.6        45.7
al         8      3618.2

sual Observations
.      C4       C1       Fit Stdev.Fit  Residual   St.Resid
      144    77.00     62.37      3.10     14.63      2.44R

enotes an obs. with a large st. resid.

T >
```

```
T > regress c1 1 c5

 regression equation is
 = 96.9 - 0.0666 C5

dictor       Coef         Stdev     t-ratio
stant      96.929         2.705       35.83
5       -0.066577      0.007095       -9.38

 6.170       R-sq = 92.6%     R-sq(adj) = 91.6%

aysis of Variance

RCE       DF          SS          MS
ession     1      3351.7      3351.7
or         7       266.5        38.1
al         8      3618.2

sual Observations
s      C5       C1       Fit Stdev.Fit  Residual   St.Resid
      499    77.00     63.72      2.72     13.28      2.40R

enotes an obs. with a large st. resid.

T >
```

```
 regression equation is
= 95.5 - 0.0175 C6

dictor        Coef          Stdev     t-ratio
stant       95.550          2.528       37.80
       -0.017478       0.001800       -9.71

 5.977       R-sq = 93.1%      R-sq(adj) = 92.1%

lysis of Variance

RCE         DF            SS            MS
ression      1        3368.1        3368.1
or           7         250.1          35.7
al           8        3618.2

sual Observations
.       C6          C1        Fit  Stdev.Fit   Residual    St.Resid
      3375       34.00      36.56       4.94      -2.56      -0.76 X
      1728       77.00      65.35       2.53      11.65       2.15R

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.
 >


 > regress c1 1 c7

 regression equation is
= 94.4 - 0.00457 C7

dictor        Coef          Stdev     t-ratio
stant       94.443          2.497       37.82
      -0.0045691      0.0004781       -9.56

 6.066       R-sq = 92.9%      R-sq(adj) = 91.9%

lysis of Variance

RCE         DF            SS            MS
ression      1        3360.6        3360.6
or           7         257.6          36.8
al           8        3618.2

sual Observations
        C7          C1        Fit  Stdev.Fit   Residual    St.Resid
     13071       34.00      34.72       5.19      -0.72      -0.23 X

enotes an obs. whose X value gives it large influence.

 >
```

EST COMBINED LOWER
DATA PORTION

```
A)  73  1
A)  68  4
A)  end
   11  ROWS  READ
 )  regress  c1  1  c2

 regression  equation  is
1 =  87.8  -  6.90  C2

rdictor           Coef             Stdev       t-ratio
stant           87.756             5.851         15.00
                -6.900             1.484         -4.65

  10.12          R-sq  =  70.6%       R-so(adj)  =  67.3%

lysis  of  Variance

RCE           DF              SS              MS
ression        1          2216.3          2216.3
ror            9           922.4           102.5
al            10          3138.7



T  )




T  )  let  c3=c2**1.5
T  )  regress  c1  1  c3

h  regression  equation  is
1 =  81.9  -  2.45  C3

rdictor           Coef             Stdev       t-ratio
stant           81.934             5.448         15.04
               -2.4537            0.6060         -4.05

  11.12          R-sq  =  64.6%       R-sq(adj)  =  60.6%

lysis  of  Variance

RCE           DF              SS              MS
ression        1          2026.4          2026.4
or             9          1112.3           123.6
al            10          3138.7



 )  let
```

```
  > regress c1 1 c4

 regression equation is
1= 78.9 - 0.921 C4

rdictor       Coef         Stdev     t-ratio
 stant      78.867         5.227       15.09
           -0.9213        0.2477       -3.72

  11.72       R-sq = 60.6%     R-sq(adj) = 56.2%

nlysis of Variance

ORCE       DF           SS           MS
eression    1       1901.7       1901.7
ror         9       1237.0        137.4
al         10       3138.7

nsual Observations
b.      C4        C1       Fit Stdev.Fit  Residual   St.Resid
       0.0    100.00     78.87      5.23     21.13       2.01R

enotes an obs. with a large st. resid.

T >




T > regress c1 1 c5

 regression equation is
1 = 77.1 - 0.357 C5

rdictor       Coef         Stdev     t-ratio
nstant      77.069         5.100       15.11
5          -0.3569        0.1014       -3.52

= 12.12       R-sq = 57.9%     R-sq(adj) = 53.2%

naysis of Variance

OURCE      DF           SS           MS
egression   1       1817.7       1817.7
rror        9       1321.0        146.8
otal       10       3138.7

nusual Observations
bs      C5        C1       Fit Stdev.Fit  Residual   St.Resid
 1     0.0    100.00     77.07      5.10     22.93       2.09R

enotes an obs. with a large st. resid.

TB >
```

COMBINED BST

```
A) 80 8
A) 77 12
A) end
  19 ROWS READ
T ) regress c1 1 c2

 regression equation is
1 = 82.2 - 2.02 C2

dictor        Coef           Stdev      t-ratio
stant       82.206           7.233        11.37
           -2.0170          0.9877        -2.04

 18.40        R-sq = 19.7%      R-sq(adj) = 15.0%

lysis of Variance

RCE           DF            SS            MS
ression        1        1411.5        1411.5
or            17        5753.7         338.5
al            18        7165.2



T )



T ) regress c1 1 c3

 regression equation is
1 = 78.8 - 0.494 C3

dictor        Coef           Stdev      t-ratio
stant       78.761           6.147        12.81
           -0.4937          0.2556        -1.93

 18.59        R-sq = 18.0%      R-sq(adj) = 13.2%

ysis of Variance

RCE           DF            SS            MS
ression        1        1289.4        1289.4
r             17        5875.7         345.6
tal           18        7165.2

ual Observations
bs        C3          C1         Fit  Stdev.Fit   Residual    St.Resid
       58.1       34.00       50.08      11.26     -16.08       -1.09 X

notes an obs. whose X value gives it large influence.

 )
```

```
T > regress c1 1 c4

h regression equation is
1 = 77.1 - 0.128 C4

dictor          Coef          Stdev      t-ratio
ostant        77.089          5.615        13.73
4           -0.12826        0.06775        -1.89

 18.66        R-sq = 17.4%      R-sq(adj) = 12.6%

nlysis of Variance

ORCE         DF         SS          MS
eression      1       1247.5      1247.5
ror          17       5917.7       348.1
al           18       7165.2

nsual Observations
b.        C4         C1        Fit  Stdev.Fit   Residual    St.Resid
         225      34.00      48.23      12.37     -14.23      -1.02 X

enotes an obs. whose X value gives it large influence.

T >



T > regress c1 1 c5

 regression equation is
1 = 76.1 - 0.0342 C5

rdictor         Coef          Stdev      t-ratio
ostant        76.137          5.301        14.36
5           -0.03418        0.01804        -1.89

 18.65        R-sq = 17.4%      R-sq(adj) = 12.6%

nlysis of Variance

ORCE         DF         SS          MS
eression      1       1249.1      1249.1
ror          17       5916.1       348.0
al           18       7165.2

nsual Observations
b         C5         C1        Fit  Stdev.Fit   Residual    St.Resid
         871      34.00      46.35      13.30     -12.35      -0.94 X

enotes an obs. whose X value gives it large influence.

T >
```

WASHINGTON

SLURRY SEAL PAVEMENTS

Includes: Regression Equations
R-squared (Confidence associated with the regression model)
t-ratio (Predictability of the dependent variable from the independent variable)
(Higher values better - typically > 4)
s or SEE (Estimate error factor - lower values are better)

Notes: c1 represents the dependent variable PCI.
c2 represents the independent variable AGE.
c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
Equations with c6 and c7 are raised to the 3 and 3.5 powers.

WA SS
1) ALL POINTS
2) UPPER POIN

```
  ) regress c1 1 c2

h regression equation is
1= 79.1 - 1.23 C2

rdictor        Coef          Stdev     t-ratio
ostant       79.078          6.631       11.92
2           -1.2300         0.5589       -2.20

 14.50       R-sq = 24.4%     R-sq(adj) = 19.4%

nlysis of Variance

ORCE          DF          SS          MS
eression       1      1018.1      1018.1
ror           15      3153.5       210.2
al            16      4171.5

nsual Observations
b.        C2        C1        Fit  Stdev.Fit   Residual    St.Resid
1        8.0     40.00      69.24       3.70     -29.24      -2.09R

enotes an obs. with a large st. resid.

T )


A ) 83 2
A ) 77 6
A ) end
   11 ROWS READ
T ) regress c1 1 c2

he regression equation is
1 = 92.6 - 2.08 C2

rdictor        Coef          Stdev     t-ratio
ostant       92.568          3.076       30.09
2           -2.0833         0.2344       -8.89

 5.343       R-sq = 89.8%     R-sq(adj) = 88.6%

nalysis of Variance

ORCE          DF          SS          MS
eression       1      2255.2      2255.2
rror           9       256.9        28.5
otal          10      2512.2



  )
```

```
MTB > regress c1 1 c3

The regression equation is
C1 = 87.3 - 0.418 C3

Predictor        Coef          Stdev     t-ratio
Constant       87.275          3.124       27.94
C3           -0.41799        0.05729       -7.30

s = 6.354        R-sq = 85.5%     R-sq(adj) = 83.9%

Analysis of Variance

SOURCE         DF          SS           MS
Regression      1      2148.9       2148.9
Error           9       363.3         40.4
Total          10      2512.2

Unusual Observations
Obs.       C3          C1          Fit  Stdev.Fit   Residual    St.Resid
  1       0.0      100.00        87.27       3.12      12.73       2.30R

R denotes an obs. with a large st. resid.

MTB >


MTB > regress c1 1 c4

The regression equation is
C1 = 84.1 - 0.0861 C4

Predictor        Coef          Stdev     t-ratio
Constant       84.102          3.232       26.03
C4           -0.08608        0.01382       -6.23

s = 7.249        R-sq = 81.2%     R-sq(adj) = 79.1%

Analysis of Variance

SOURCE         DF          SS           MS
Regression      1      2039.3       2039.3
Error           9       472.9         52.5
Total          10      2512.2

Unusual Observations
Obs.       C4          C1          Fit  Stdev.Fit   Residual    St.Resid
  1         0      100.00        84.10       3.23      15.90       2.45R

R denotes an obs. with a large st. resid.

MTB >
```

```
MT > regress c1 1 c5

Th regression equation is
C1 = 82.0 - 0.0180 C5

 dictor        Coef          Stdev     t-ratio
Constant      82.029         3.333       24.61
C5         -0.018009      0.003259       -5.53

s  7.972       R-sq = 77.2%      R-sq(adj) = 74.7%

Analysis of Variance

SOURCE        DF          SS           MS
Regression     1      1940.2       1940.2
Error          9       572.0         63.6
Total         10      2512.2

Unusual Observations
Obs.       C5         C1        Fit  Stdev.Fit   Residual    St.Resid
            0     100.00      82.03       3.33      17.97       2.48R

R enotes an obs. with a large st. resid.

MT >
```

OREGON

SLURRY SEAL PAVEMENTS

Includes:	Regression Equations
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	t-ratio (Predictability of the dependent variable from the independent variable) (Higher values better - typically > 4)
	s or SEE (Estimate error factor - lower values are better)

Notes:	c1 represents the dependent variable PCI.
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	Equations with c6 and c7 are raised to the 3 and 3.5 powers.

OR SS

```
A> 65 1
A> 64 5
A> end
    7 ROWS READ
 > regress c1 1 c2

h regression equation is
1= 83.0 - 3.94 C2

rdictor         Coef           Stdev      t-ratio
stant         82.967           6.853        12.11
              -3.939           1.890        -2.08

 11.16         R-sq = 46.5%      R-sq(adj) = 35.8%

nlysis of Variance

RCE          DF           SS            MS
eression      1        540.7         540.7
ror           5        622.7         124.5
al            6       1163.4



T  >




T  > let c3=c2**1.5
T  > regress c1 1 c3

h regression equation is
1= 79.9 - 1.37 C3

rdictor         Coef           Stdev      t-ratio
stant         79.913           6.684        11.96
             -1.3702          0.8105        -1.69

 12.17         R-sq = 36.4%      R-sq(adj) = 23.6%

nlysis of Variance

RCE          DF           SS            MS
eression      1        423.1         423.1
ror           5        740.3         148.1
al            6       1163.4


   >
```

```
MTB > let c4=c2**2
MTB > regress c1 1 c4

The regression equation is
C1 = 78.5 - 0.516 C4

Predictor        Coef           Stdev      t-ratio
Constant       78.492           6.590        11.91
C4            -0.5157          0.3443        -1.50

s = 12.67        R-sq = 31.0%      R-sq(adj) = 17.2%

Analysis of Variance

SOURCE         DF            SS            MS
Regression      1         360.3         360.3
Error           5         803.1         160.6
Total           6        1163.4


MTB >
```

```
MTB > let c5=c2**2.5
MTB > regress c1 1 c5

The regression equation is
C1 = 77.7 - 0.201 C5

Predictor        Coef           Stdev      t-ratio
Constant       77.672           6.554        11.85
C5            -0.2008          0.1462        -1.37

s = 13.00        R-sq = 27.4%      R-sq(adj) = 12.9%

Analysis of Variance

SOURCE         DF            SS            MS
Regression      1         318.7         318.7
Error           5         844.7         168.9
Total           6        1163.4


MTB >
```

OR SS
W/O PCI = 100%
@ AGE = 0

```
)A A>  65  1
)A A>  64  5
)A A>  end
     6 ROWS READ
T  >  regress c1  1  c2

h  regression equation is
1= 72.7  -  1.70 C2

rdictor           Coef             Stdev      t-ratio
ostant          72.658             4.874        14.91
2               -1.697             1.245        -1.36

  6.265         R-sq  = 31.7%       R-sq(adj)  =  14.7%

nlysis of Variance

ORCE          DF              SS               MS
eression       1           72.99            72.99
ror            4          157.01            39.25
oal            5          230.00



T  >




T  >  let c3=c2**1.5
T  >  regress c1  1  c3

h  regression equation is
1 = 71.2  -  0.606 C3

rdictor           Coef             Stdev      t-ratio
ostant          71.233             4.190        17.00
3              -0.6064            0.4704        -1.29

  6.373         R-sq  = 29.4%       R-sq(adj)  =  11.7%

nlysis of Variance

ORCE          DF              SS               MS
eression       1           67.51            67.51
r              4          162.49            40.62
a              5          230.00
```

```
T > let c4=c2**2
  > regress c1 1 c4

n regression equation is
1= 70.5 - 0.230 C4

rdictor         Coef            Stdev      t-ratio
ostant        70.523            3.958        17.82
4            -0.2298           0.1910        -1.20

 6.502         R-sq = 26.5%      R-sq(adj) = 8.1%

nlysis of Variance

ORCE          DF             SS             MS
eression       1          60.89          60.89
ror            4         169.11          42.28
oal            5         230.00



T >



T > let c5=c2**2.5
  > regress c1 1 c5

h regression equation is
1= 70.1 - 0.0884 C5

rdictor         Coef            Stdev      t-ratio
ostant        70.060            3.876        18.06
5           -0.08843          0.08006        -1.10

 6.638         R-sq = 23.4%      R-sq(adj) = 4.2%

nlysis of Variance

ORCE          DF             SS             MS
eression       1          53.76          53.76
ror            4         176.24          44.06
oal            5         230.00



T >
```

COMBINED

SLURRY SEAL
PAVEMENTS

Includes:
Regression Equations
R-squared (Confidence associated with the regression model)
t-ratio (Predictability of the dependent variable from the independent variable)
(Higher values better - typically > 4)
s or SEE (Estimate error factor - lower values are better)

Notes:
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Equations with c6 and c7 are raised to the 3 and 3.5 powers.

COMBINED SS

```
 regression equation is
1= 74.9 - 0.978 C2

rdictor         Coef          Stdev      t-ratio
cstant        74.908          4.502        16.64
2            -0.9784         0.4331        -2.26

 12.99        R-sq = 19.5%      R-sq(adj) = 15.7%

nlysis of Variance

ORCE        DF           SS           MS
eression     1        860.5        860.5
ror         21       3541.4        168.6
oal         22       4401.9

nsual Observations
b.        C2         C1        Fit  Stdev.Fit   Residual    St.Resid
         0.0     100.00      74.91       4.50      25.09       2.06R
1        8.0      40.00      67.08       2.71     -27.08      -2.13R

enotes an obs. with a large st. resid.

T >




h regression equation is
1= 72.6 - 0.200 C3

rdictor         Coef          Stdev      t-ratio
ostant        72.585          3.841        18.90
3           -0.20018        0.09310        -2.15

 13.11        R-sq = 18.0%      R-sq(adj) = 14.1%

nlysis of Variance

ORCE        DF           SS           MS
eression     1        794.3        794.3
ror         21       3607.6        171.8
oal         22       4401.9

nsual Observations
b.         C3         C1        Fit  Stdev.Fit   Residual    St.Resid
          0.0     100.00      72.58       3.84      27.42       2.19R
         96.2      55.00      53.32       6.83       1.68       0.15 X
         96.2      43.00      53.32       6.83     -10.32      -0.92 X
1        22.6      40.00      68.06       2.80     -28.06      -2.19R

TINUE?
```

```
Th regression equation is
C1 = 71.5 - 0.0436 C4

edictor        Coef          Stdev     t-ratio
nstant       71.498          3.514       20.35
C4         -0.04364        0.02041       -2.14

s = 13.12        R-sq = 17.9%     R-sq(adj) = 14.0%

Anlysis of Variance

SURCE          DF          SS           MS
Reression       1       787.0        787.0
Eror           21      3615.0        172.1
Tcal           22      4401.9

Unsual Observations
Ob.         C4         C1        Fit  Stdev.Fit   Residual    St.Resid
             0     100.00      71.50       3.51      28.50       2.25R
           441      55.00      52.25       7.33       2.75       0.25 X
           441      43.00      52.25       7.33      -9.25      -0.85 X
 1          64      40.00      68.70       2.88     -28.70      -2.24R

CITINUE?




 regression equation is
C1 = 70.9 - 0.00973 C5

Prdictor       Coef          Stdev     t-ratio
Costant      70.886          3.324       21.32
C5        -0.009729       0.004497       -2.16

s = 13.09        R-sq = 18.2%     R-sq(adj) = 14.3%

Arlysis of Variance

SURCE          DF          SS           MS
Reression       1       802.3        802.3
Error          21      3599.6        171.4
Tcal           22      4401.9

Unsual Observations
Ob.         C5         C1        Fit  Stdev.Fit   Residual    St.Resid
             0     100.00      70.89       3.32      29.11       2.30R
          2021      55.00      51.22       7.69       3.78       0.36 X
          2021      43.00      51.22       7.69      -8.22      -0.78 X
 1         181      40.00      69.12       2.94     -29.12      -2.28R

CTINUE?
```

COMBINED SS
w/o HIP

```
e regression equation is
1 = 74.9 - 1.19 C2

redictor        Coef          Stdev      t-ratio
onstant       74.890          4.168        17.97
2            -1.1871         0.4152        -2.86

 = 12.00       R-sq = 30.1%     R-sq(adj) = 26.4%

nalysis of Variance

OURCE          DF          SS          MS
egression       1      1177.1      1177.1
rror           19      2735.9       144.0
otal           20      3913.0

nusual Observations
bs.       C2         C1        Fit  Stdev.Fit   Residual    St.Resid
 1       0.0     100.00      74.89       4.17      25.11       2.23R
13       8.0      40.00      65.39       2.62     -25.39      -2.17R

 denotes an obs. with a large st. resid.

TB >


he regression equation is
1 = 71.9 - 0.234 C3

redictor        Coef          Stdev      t-ratio
onstant       71.928          3.628        19.83
3           -0.23366        0.09011        -2.59

 = 12.33       R-sq = 26.1%     R-sq(adj) = 22.3%

nalysis of Variance

OURCE          DF          SS          MS
egression       1      1022.8      1022.8
rror           19      2890.2       152.1
otal           20      3913.0

nusual Observations
bs.       C3         C1        Fit  Stdev.Fit   Residual    St.Resid
 1       0.0     100.00      71.93       3.63      28.07       2.38R
 3      96.2      55.00      49.44       6.79       5.56       0.54 X
 5      96.2      43.00      49.44       6.79      -6.44      -0.63 X
13      22.6      40.00      66.64       2.72     -26.64      -2.21R

NTINUE?
```

```
he regression equation is
1 = 70.5 - 0.0487 C4

edictor        Coef           Stdev      t-ratio
onstant      70.529           3.383        20.85
4          -0.04873         0.01984        -2.46

 = 12.50       R-sq = 24.1%      R-sq(adj) = 20.1%

nalysis of Variance

OURCE        DF          SS           MS
egression     1       942.8        942.8
rror         19      2970.1        156.3
otal         20      3913.0

nusual Observations
bs.       C4        C1         Fit  Stdev.Fit   Residual    St.Resid
 1         0    100.00       70.53       3.38      29.47       2.45R
 3       441     55.00       49.04       7.28       5.96       0.59 X
 5       441     43.00       49.04       7.28      -6.04      -0.59 X
13        64     40.00       67.41       2.82     -27.41      -2.25R

ONTINUE?




e regression equation is
1 = 69.8 - 0.0104 C5

redictor       Coef           Stdev      t-ratio
nstant       69.759           3.252        21.45
5         -0.010437        0.004383        -2.38

 = 12.59       R-sq = 23.0%      R-sq(adj) = 18.9%

alysis of Variance

URCE         DF          SS           MS
gression      1       899.3        899.3
ror          19      3013.7        158.6
tal          20      3913.0

usual Observations
s.        C5        C1         Fit  Stdev.Fit   Residual    St.Resid
 1         0    100.00       69.76       3.25      30.24       2.49R
 3      2021     55.00       48.67       7.63       6.33       0.63 X
 5      2021     43.00       48.67       7.63      -5.67      -0.57 X
13       181     40.00       67.87       2.91     -27.87      -2.27R

NTINUE?
```

WASHINGTON PCC PAVEMENTS

Includes: Regression Equations
R-squared (Confidence associated with the regression model)
t-ratio (Predictability of the dependent variable from the independent variable)
(Higher values better - typically > 4)
s or SEE (Estimate error factor - lower values are better)

Notes: c1 represents the dependent variable PCI.
c2 represents the independent variable AGE.
c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
Equations with c6 and c7 are raised to the 3 and 3.5 powers.

WA PCC

```
TB > regress c1 1 c2

he regression equation is
1 = 99.5 - 0.884 C2

redictor        Coef           Stdev     t-ratio
onstant        99.51           23.19        4.29
2            -0.8839          0.5238       -1.69

 = 23.51       R-sq = 18.0%      R-sq(adj) = 11.7%

nalysis of Variance

OURCE        DF           SS           MS
egression     1       1574.3       1574.3
rror         13       7186.6        552.8
otal         14       8760.9

nusual Observations
bs.       C2         C1        Fit  Stdev.Fit   Residual    St.Resid
 1       0.0     100.00      99.51      23.19       0.49       0.13 X

 denotes an obs. whose X value gives it large influence.

TB >


TB > regress c1 1 c3

he regression equation is
1 = 98.5 - 0.127 C3

redictor        Coef           Stdev     t-ratio
onstant        98.47           22.86        4.31
3          -0.12696         0.07614       -1.67

 = 23.56       R-sq = 17.6%      R-sq(adj) = 11.3%

nalysis of Variance

OURCE        DF           SS           MS
egression     1       1543.6       1543.6
rror         13       7217.3        555.2
otal         14       8760.9

nusual Observations
bs.       C3         C1        Fit  Stdev.Fit   Residual    St.Resid
 1         0     100.00      98.47      22.86       1.53       0.27 X

 denotes an obs. whose X value gives it large influence.

B >
```

```
TB > regress c1 1 c4

he regression equation is
1 = 97.0 - 0.0180 C4

redictor        Coef          Stdev     t-ratio
onstant        97.02          22.43        4.33
4           -0.01800        0.01101       -1.64

 = 23.64       R-sq = 17.1%     R-sq(adj) = 10.7%

nalysis of Variance

OURCE        DF           SS          MS
egression     1       1494.3      1494.3
rror         13       7266.7       559.0
otal         14       8760.9

nusual Observations
bs.       C4          C1        Fit  Stdev.Fit   Residual    St.Resid
 1         0    100.00      97.02      22.43       2.98       0.40 X

 denotes an obs. whose X value gives it large influence.

TB >



TB > regress c1 1 c5

e regression equation is
1 = 95.3 - 0.00252 C5

redictor        Coef          Stdev     t-ratio
onstant        95.25          21.92        4.35
5          -0.002522       0.001584       -1.59

 = 23.75       R-sq = 16.3%     R-sq(adj) = 9.9%

nalysis of Variance

OURCE        DF           SS          MS
egression     1       1430.5      1430.5
rror         13       7330.4       563.9
otal         14       8760.9

nusual Observations
bs.       C5          C1        Fit  Stdev.Fit   Residual    St.Resid
 1         0    100.00      95.25      21.92       4.75       0.52 X

 denotes an obs. whose X value gives it large influence.

TB >
```

OREGON PCC PAVEMENTS

Includes:
- Regression Equations
- R-squared (Confidence associated with the regression model)
- t-ratio (Predictability of the dependent variable from the independent variable)
  - (Higher values better - typically > 4)
- s or SEE (Estimate error factor - lower values are better)

Notes:
- c1 represents the dependent variable PCI.
- c2 represents the independent variable AGE.
- c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
- Equations with c6 and c7 are raised to the 3 and 3.5 powers.

(CONDON STATE) /2

```
ATA> 94 1
ATA> 78 5
ATA> end
     3 ROWS READ
TB > regress c1 1 c2

he regression equation is
1 = 99.2 - 4.29 C2

redictor        Coef          Stdev      t-ratio
onstant      99.2381         0.9712       102.18
2            -4.2857         0.3299       -12.99

 = 1.234       R-sq = 99.4%      R-sq(adj) = 98.8%

nalysis of Variance

OURCE       DF           SS           MS
egression    1       257.14       257.14
rror         1         1.52         1.52
otal         2       258.67


TB >


TB > plot c1 c2

       -
       - *
   98.0+
       -
1      -
       -           *
       -
   91.0+
       -
       -
       -
       -
   84.0+
       -
       -
       -
       -                                                   *
   77.0+
       -
         +---------+---------+---------+---------+---------+------C2
       0.0       1.0       2.0       3.0       4.0       5.0

TB >
```

COMBINED PCC PAVEMENTS

Includes:
Regression Equations
R-squared (Confidence associated with the regression model)
t-ratio (Predictability of the dependent variable from the independent variable)
(Higher values better - typically > 4)
s or SEE (Estimate error factor - lower values are better)

Notes:
c1 represents the dependent variable PCI.
c2 represents the independent variable AGE.
c3, c4, c5 are AGE raised to 1.5, 2, 2.5 powers, respectively.
Equations with c6 and c7 are raised to the 3 and 3.5 powers.

PCL COMPOSITE

```
ITB > regress c1 1 c2

he regression equation is
1 = 92.4 - 0.731 C2

redictor         Coef          Stdev     t-ratio
onstant         92.40          13.29        6.95
2             -0.7308         0.3194       -2.29

 = 22.15        R-sq = 25.9%     R-sq(adj) = 20.9%

nalysis of Variance

OURCE        DF          SS          MS
egression     1      2568.6      2568.6
rror         15      7359.5       490.6
otal         16      9928.1

nusual Observations
bs.       C2         C1         Fit  Stdev.Fit   Residual    St.Resid
 1       0.0     100.00       92.40      13.29       7.60       0.43 X

 denotes an obs. whose X value gives it large influence.

ITB >

ITB > read c3=c2**2
 ERROR * ARGUMENT IS A CONSTANT OR MATRIX, BUT A COLUMN WAS EXPECTED

TB > let c3=c2**2
 B > regress c1 1 c3

he regression equation is
1 = 90.1 - 0.0147 C3

redictor         Coef          Stdev     t-ratio
onstant         90.10          12.70        7.09
3           -0.014737       0.006638       -2.22

 = 22.32        R-sq = 24.7%     R-sq(adj) = 19.7%

nalysis of Variance

OURCE        DF          SS          MS
egression     1      2455.3      2455.3
rror         15      7472.8       498.2
otal         16      9928.1



ITB >




 B > let c4=c2**2.5
ITB > regress c1 1 c4

he regression equation is
1 = 89.5 - 0.00212 C4

redictor         Coef          Stdev     t-ratio
```

```
s = 22.39         R-sq = 24.3%      R-sq(adj) = 19.2%

Analysis of Variance

SOURCE        DF          SS          MS
  gression     1      2409.0      2409.0
Error         15      7519.1       501.3
Total         16      9928.1


MTB > let c5=c2**



MTB > let c5=c2**3
MTB > regress c1 1 c5

The regression equation is
C1 = 88.8 -0.000305 C5

Predictor       Coef         Stdev     t-ratio
Constant       88.82         12.47        7.12
C5        -0.0003047     0.0001410       -2.16

s = 22.47         R-sq = 23.7%      R-sq(adj) = 18.6%

Analysis of Variance

SOURCE        DF          SS          MS
  gression     1      2356.0      2356.0
Error         15      7572.2       504.8
Total         16      9928.1


MTB >
```

APPENDIX E

IDAHO STATE
GENERAL AVIATION
PAVEMENT CONDITION SURVEY DATA

INCLUDING:

1) AIRPORT LOCATION/DESCRIPTION/SECTION DATA
2) PAVEMENT IDENTIFICATION & CHARACTERISTICS
3) AVERAGE PCI VALUES FOR PAVEMENT FEATURES
4) PAVEMENT CONDITION SURVEY DATES
5) REPAIR AND REHABILITATION INFORMATION

IDAHO AIRPORT PAVEMENT CHARACTERISTICS AND 1986 PCI

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RRD	EXISTING STRUCTURE	PCI - 1986
1	ARCO (BUTTE COUNTY) AP	R1	1979	2"AC, 4"B, 6"SB		2"AC, 4"B, 6"SB	66
2	BEAR LAKE COUNTY AP	R1	UNK	2"AC, 6"B, 10"SB		2"AC, 6"B, 10"SB	27
		R2	1984	2"AC, 2"B, 4"SB		2"AC, 2"B, 4"SB	96
3	BUHL MUNICIPAL AP	R1	1983	2"AC, 4"B, 6"SB		2"AC, 4"B, 6"SB	69
4	BURLEY MUNICIPAL AP	R1	UNK	2.5"AC, 12"B	1980	SC, 2"ACOL,2.5"AC,12"B	67
		R2	UNK	2.5"AC, 10"B	UNK	SC, ?OL, 2.5"AC, 10"B	56
5	CALDWELL AP	R1	1975	2"AC,4"B,5"SB,7"FC	1986	SS,FS,2"AC,4"B,5"SB,7"FC	94
		R2	1975	2"AC,4"B,5"SB,7"FC	1986	SS,FS,2"AC,4"B,5"SB,7"FC	100
6	CHALLIS AP	R1	1973	BST, 6"B	1986	FS,2"ACOL, BST, 6"B	79
7	COEUR D'ALENE AIR TERMINAL	R1	UNK	2"AC, 6"B	1973	SS, 3"ACOL, 2"AC, 6"B	77
		R2	UNK	2"AC, 6"B	1973	SS, 3"ACOL, 2"AC, 6"B	79
		R3	UNK	2"AC, 6"B	1973	SS, 3"ACOL, 2"AC, 6"B	79
		R4	UNK	3"AC, 8"B	1973	SS, 3"AC, 8"B	89
8	CRAIGMONT MUNICIPAL AP	R1	1975	1"AC, 5"B, 10"SB	1983	CS, FS, 1"AC, 5"B, 10"SB	57
9	DRIGGS MUNICIPAL AP	R1	1975	2"AC, 4"B, 6"SB		2"AC, 4"B, 6"SB	81
10	GOODING MUNICIPAL AP	R1	1978	2"AC, 8"B	1985	SS, 2"AC, 8"B	86
11	GRANGEVILLE (IDAHO CO.) AP	R1	1965	3"AC, 12"B, 12"SB	1983	2"ACOL, 3"AC, 12"B, 12"SB	71
		R2	1983	4"AC, 18"B		4"AC, 18"B	73
		R3	1983	4"AC, 18"B		4"AC, 18"B	73
12	JEROME COUNTY AP	R1	UNK	7.5"AC, 3.5"B	1975	CS, FS, 7.5"AC, 3.5"B	65
		R2	1981	2"AC, 4"B, 6"SB		2"AC, 4"B, 6"SB	90
13	KELLOGG (SHOSHONE CO.) AP	R1	UNK	1"AC, 4"B, 24"SB	1980	1"ACOL, 1"AC, 4"B, 24"SB	94
		R2	UNK	1"AC, 5"B, 24"SB	1980	1"ACOL, 1"AC, 5"B, 24"SB	94
		R3	UNK	1.5"AC, 5"B	1983	SS, 1.5"AC, 5"B	40
		R4	UNK	1"AC, 5"B, 24"SB	1980	3"ACOL, 1"AC, 5"B, 24"SB	96
		R5	UNK	1"AC, 4"B, 24"SB	1980	3"ACOL, 1"AC, 4"B, 24"SB	93
14	McCALL MUNICIPAL AP	R1	1974	3"AC, 6"B	1985	SS, 3"AC, 6"B	87
15	MOUNTAIN HOME MUNICIPAL AP	R1	1973	2"AC, 7.5"B, 8"SB		2"AC, 7.5"B, 8"SB	70
16	NAMPA MUNICIPAL AP	R1	1976	2"AC, 3"B, 8"SB	1985	SS, FS, 2"AC, 3"B, 8"SB	91
17	OROFINO MUNICIPAL AP	R1	1969	2"AC, 4"B, 4"SB	UNK	SS, 2"AC, 4"B, 4"SB	81
18	PRIEST RIVER MUNICIPAL AP	R1	1975	2.5"AC, 6"B	UNK	SS, 2.5"AC, 6"B	86

IDAHO AIRPORT PAVEMENT CHARACTERISTICS AND 1986 PCI

No.	AIRPORT & LOCATION	ID	OCD	ORIG. STRUC. SEC.	RRD	EXISTING STRUCTURE	PCI - 1986
19	REXBURG (MADISON COUNTY) AP	R1	1972	2"AC, 6"B, 6"SB	UNK	SS, 2"AC, 6"B, 6"SB	63
		R3	1977	2.5"AC, 6"B, 6"SB	UNK	SS, 2.5"AC, 6"B, 6"SB	71
		R4	1977	2.5"AC, 8"B, 12"SB	UNK	SS, 2.5"AC, 8"B, 12"SB	61
20	ST. MARIES MUNICIPAL AP	R1	1978	1.5"AC, 11"B, NWF		1.5"AC, 11"B, NWF	59
21	SANDPOINT AP	R1	1952	BST, 6"B, 6"SB	UNK	DBST, 6"B, 6"SB	24
		R2	UNK	2"AC, ?B, ?SB		2"AC, ?B, ?SB	45
22	SODA SPRINGS AP	R1	1969	2.5"AC, ?B, ?SB	1983	SS, 2.5"AC, ?B, ?SB	42

Thesis
F52283 Floro
c.1
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